PUBLIC WORKS

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VOL. 71. NO. 5

A. PRESCOTT FOLWELL, Editor

W. A. HARDENBERGH, Asso. Editor

Timewasters

This month we are specializing on the problems of the grocers—a worthy and necessary group; and we shall consider also their problems in regard to selling ham.

The first grocer had an old-fashioned balance scale like that used by the statue of Justice. But one day some mischievous kids stole all but three of his weights. Being of a timewasting turn of mind, he fiddled around with these weights and found that he could, by using both pans of the scale, weigh any amount from 1 to 13 pounds. What were these three weights?

The second grocer made a balance scale for himself. He weighed a ham in the pan on one side of the scale, this, too, being a statue of Justice model scale, and found the ham weighed 7 pounds and no ounces. Filled with inborn caution, he then put it in the other pan and weighed it, finding, to his consternation, that it weighed 9 pounds and 2 ounces on that side. Figuring that maybe his pans were of unequal weight, he took them next door to another grocer, who had an honest-to-goodness scale, and weighed them. They were exactly the same in weight, each weighing 1 pound, but the neighbor grocer would not weigh the ham for him. So he figured out the weight of the ham. Can you? From *The Pioneer.*

But enough of grocers. Here's a time problem—suitable for "timewasters." The hands of a clock show that it is twenty minutes past one; what time would it be if the hour and minute hands were reversed? *ARBA News.*

CONTENTS FOR MAY, 1940

EDITORIAL 19

HIGHWAYS AND STREETS:

79% of County Roads Are Built by Force Account 9
Maintenance Savings on Modern Bridges Pay for Replacing Old Bridges 20
How Counties Maintain Highway Equipment 24
Two Miles a Week of Bituminous Stabilization With WPA 26
High Speed Highway Lane Marking With Automatic Device for Dash Lines. *By Charles R. Waters* 34
Non-Rattling Wooden Bridge Floors 39

SEWERAGE AND SANITATION:

Attractive Sewage Treatment Plant Located at Edge of Village. *By E. E. Bardwell* 16
Owatonna's High Capacity Filter Plant 18
Effluent From Activated Secondary Tank 18
Trickling Filter Equipment and Operation Practices 28
The Sewerage Digest 44

WATER SUPPLY AND PURIFICATION:

Municipal Recreation Field in Vermont Includes Asphalt Swimming Pool. *By A. D. Bishop* 12
An Attractive Small Water Plant 15
Moving a Water Main Under Pressure 27
The Water Works Digest 40

DEPARTMENTS:

Keeping Up With New Equipment 51
Readers' Service 55
The Engineer's Library 58

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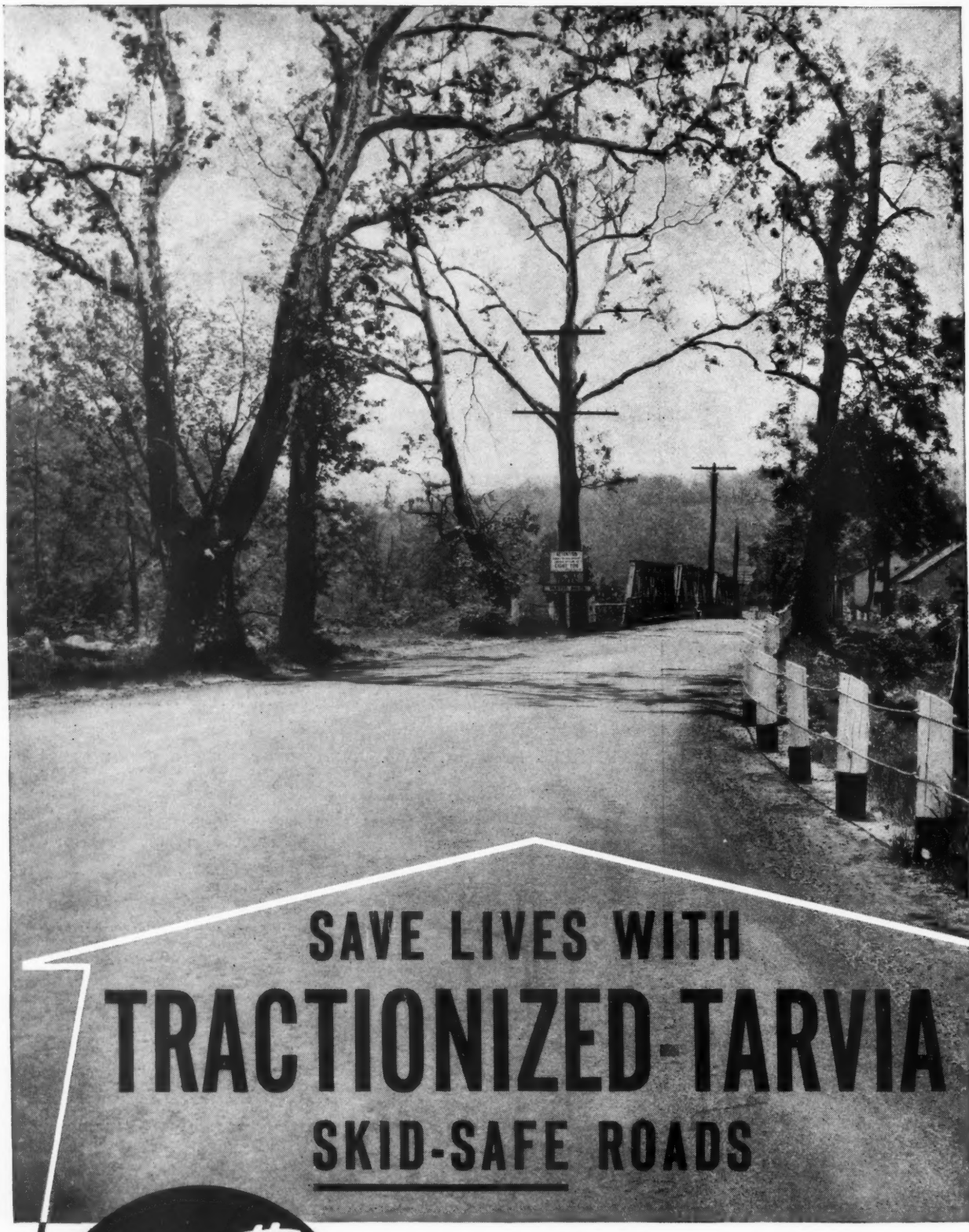

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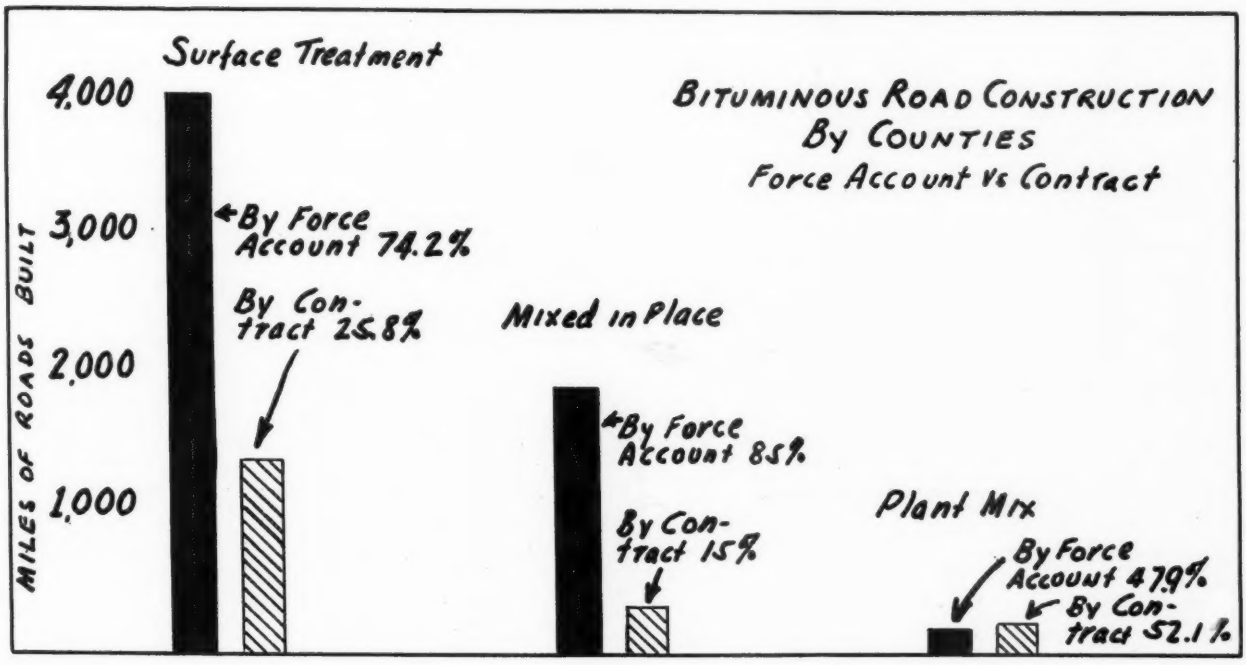


79% of County Roads Are Built by Force Account

Survey Shows Probable 35% Increase in Construction for 1940

A STUDY of road building activities throughout the Nation has been made by PUBLIC WORKS Magazine covering 790 counties in 39 states. However the six New England states and Pennsylvania carry on practically no county highway activity and Virginia and North Carolina have no county organization. Excluding these states and Delaware, Louisiana, Maryland, Nevada and New Mexico, 775 counties were included in the survey.

Reports received from these counties covered slightly more than 40,000 miles of road construction during 1939 and indicated the type of construction; whether the work was done by contract or force account; WPA assistance if any; the mileage of each type constructed by each county; and probable construction for the coming year.

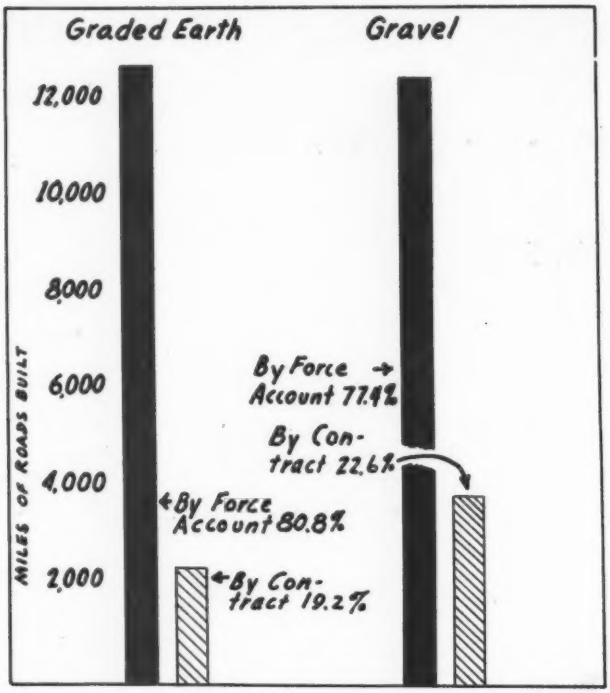
Probable Construction During 1940:

Figures reported by these counties indicate that definite plans have already been made for building 12,905 miles of earth roads; 12,316 miles of gravel roads; 3,733 miles of surface treatment; 2,270 miles of mixed-in-place; 294 miles of plant mix; and 1,060 miles of surface for which the type has not definitely been selected. This is a total already planned of 32,578 miles.

Inasmuch as this questionnaire went out early in the year before plans had been completed in a number of the states, this is a promising showing. Experience in the past indicates that it is conservative to estimate that these advance estimates represent 60% of the work that will be done. On this basis (which has been determined by checking estimated and actual work reported in past years) the probable construction by these counties will amount to approximately 54,000 miles in 1940, an increase of about 35% over 1939.

Graded Road Construction:

Construction of graded earth roads was reported by 516 counties, totalling 15,247 miles of roads. Of



Force account and contract construction of earth and gravel roads.

these 516 counties, 417 or 80.8% employed force account for construction, and 99 or 19.2% had the work done by contract. Considering only the 417 counties in which work was done by force account, WPA aided in 100, or slightly less than 25%. The work done by force account totalled 12,792 miles, as compared with 2,455 miles done by contract methods. The average mileage of roads constructed in the 417 counties reporting force account was 30.7 miles; the average constructed by contract in the 99 counties was 24.7 miles.

Contract construction predominated in Minnesota where 44 counties reported contract construction covering 1239 miles, as compared to 26 counties doing the work with their own forces with a total of 563 miles. Contract methods were of importance also in Iowa, Illinois, Michigan and Texas. No contract work was done in 17 states, force account work only being employed; only one state reported no work done by force account.

Kansas was the biggest builder of graded road construction, with 86 counties reporting 2,328 miles constructed by force account and 3 miles by contract; Iowa constructed 133 miles by force account and 708 by contract; Minnesota, 563 by force account and 1,239 by contract.

Gravel Road Construction:

A total of 16,614 miles of gravel roads were reported as being built by 526 counties. Of the total mileage, 23.8% was constructed by contract and 76.4% by force account. Of the 526 counties, 407 or 77.4% did their work by force account, WPA assisting in 142 of the counties; 119 counties, or 22.6% carried on this work by contract, and built a total of 3,962 miles as against 12,652 built by force account. The average length of construction per county where force account was employed was 31 miles, and where contract system was employed 33 miles.

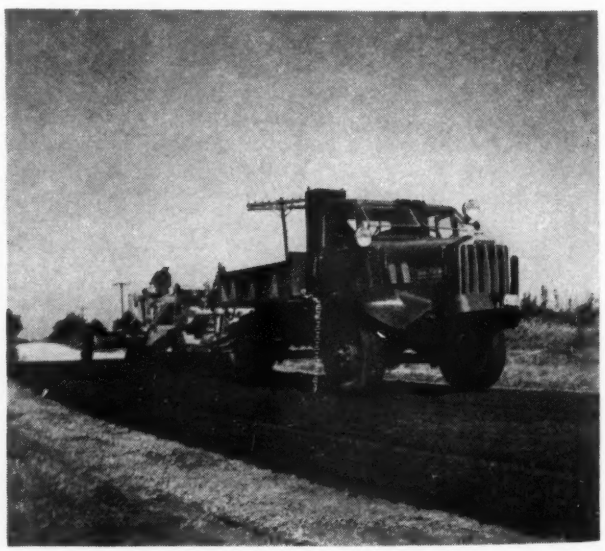
Some counties in every state reporting did some work by force account, but in 15 of the states no county reported gravel road construction by contract. In two states, contract methods predominated — Minnesota, where 39 counties built 1,521 miles of gravel road by contract and 27 counties built 1,484 miles by force account; and Iowa, where 30 counties reported construction by contract of 1,069 miles and 28 counties reported force account construction of 778 miles. In Kansas, the other extreme was registered, with 50 counties reporting 1,619 miles done by force account and no contract work. In Illinois, 31 counties built 890 miles by force account and 13 counties built 258 miles by contract. Iowa and Minnesota accounted for about 60% of the contract work done.

Surface Treatment:

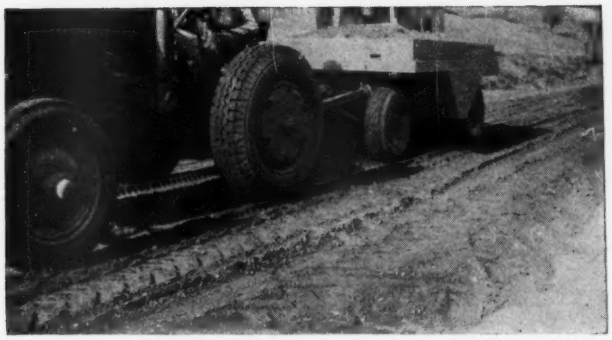
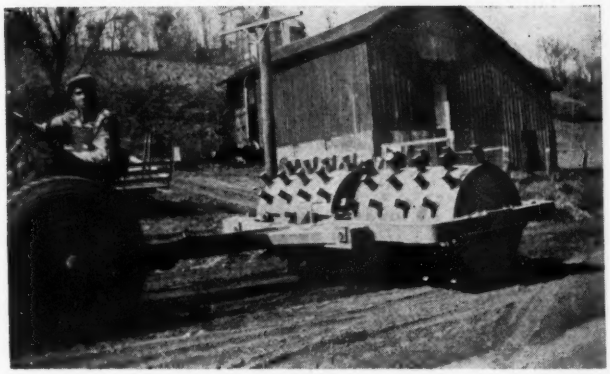
Surface treatment totalling 5,476 miles was reported by 211 counties in 28 states. Of this total, 4,061 miles or 74.2% was done by force account and 1,415 miles or 25.8% by contract. Of the 211 counties, 161 (with WPA assistance in 29 cases), or 76.3%, reported work done by force account; and 50 or 23.7% did the work by contract. Work per county where force account construction ruled amounted to 25.2 miles; under contract methods, it averaged 28.3 miles per county.

In Ohio 29 counties reported 1,245 miles of surface

Every county should own modern rollers of proper size.



Constructing a modern surface in an Indiana county.

Counties will find many uses in economical construction for such equipment as is shown here.

treatment, of which 20 counties constructed 798 miles by force account and 9 counties did 447 miles by contract. Iowa was the only state where contract methods were employed almost exclusively (6 miles by force account and 280 by contract), but Minnesota also favored contract construction (77 miles by force account as compared to 210 by contract). Florida, Illinois, Michigan, New Jersey, New York, and Wisconsin were among the states where force arcount construction was employed exclusively or predominantly; 21 counties in Michigan reported 298 miles by force account and 13 miles by contract; 16 counties in Wisconsin built 633 miles by force account and 3 by contract.

Mixed-in-Place:

A total of 2,280 miles of mixed-in-place surface was reported as built in 1939 by 166 counties, an average of 13.7 miles per county. Of this total, 1939 miles were constructed by force account—85%—and 341 miles by contract, or 15%. Of the 166 counties, 119 or 71.7% did their mixed-in-place work by force account, and 47 or 28.3% carried on such construction by contract. These 166 counties were located in 23 states.

Minnesota was the only state in which contract construction predominated; 17 counties reported 13 miles by force account and 113 by contract; 22 counties in Ohio reported 208 miles by force account and 128 miles by contract. On the other hand, Wisconsin built, according to reports from 14 counties, 518 miles by force account and none by contract; 16 counties in Michigan built 151 miles by force account and 6 by contract; Indiana, with 20 counties reporting, built 189 miles by force account and 21 miles by contract.

In 19 of the 119 counties where force account work was carried on, the WPA cooperated in constructing this type of surface.

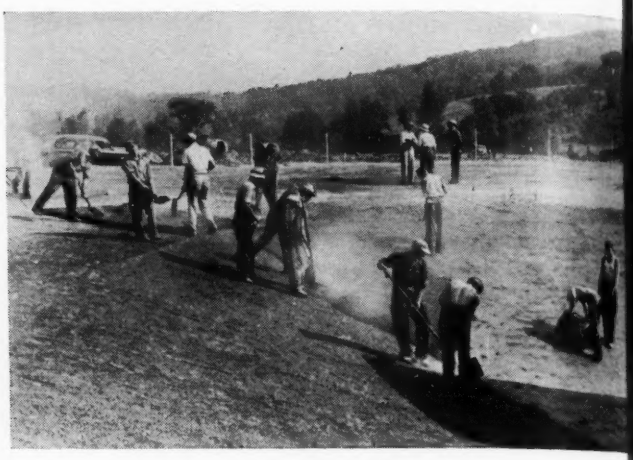
Plant-Mix Surfaces:

Plant-mix construction was reported by 40 counties in 17 states, totalling 405 miles of road, or an average of about 10 miles per county. In 21 counties the work was done by force account and in 19 it was done by contract; the 21 counties (WPA participating in 7) constructed by force account 194 miles; contract construction in 19 counties amounted to 211 miles.

Illinois led in this type of construction, 8 counties reporting 100 miles, of which 44 was done by contract; 3 counties in Minnesota reported 67 miles, 55 of which was constructed by contract. Kansas, California, New York and Texas were other states reporting substantial mileages of plant-mix.

Please turn to page 36 for further data and for comments by officials.

	Number of Counties			Miles Built	
Surface	*Reporting*	*Force Account*	*Contract*	*Force Account*	*Contract*
Grading	516	417	99	12,792	2,455
Graveling	526	407	119	12,652	3,962
Surface Treating	211	161	50	4,061	1,415
Road Mix	166	119	47	1,939	341
Plant Mix	40	21	19	194	211
				31,638	8,384
				79%	21%



A. D. Bishop turns to observe the progress. Each course was laid in layers and each layer thoroughly tamped.

Municipal Recreational Field in Vermont

By A. D. BISHOP
Consulting Engineer

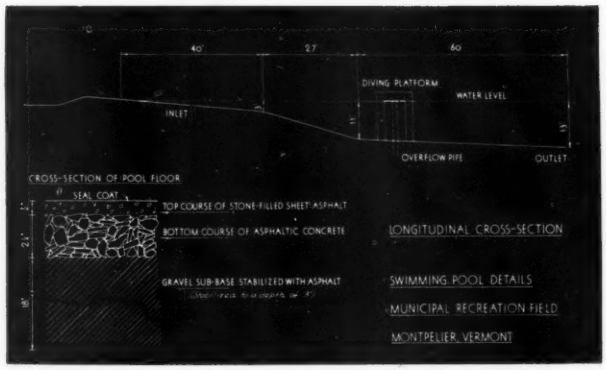
A MUNICIPAL recreation field—the dream of its citizens for years—has recently been completed by the City of Montpelier, Vt. (Pop. 8,000). Originally conceived as simply a swimming pool for youngsters, the availability of a Public Works Administration grant made it possible to amplify the design to include other sports facilities for the same expenditure on the City's part. The completed development consists of a swimming pool, bathhouse, baseball diamond, football field, running track and children's playground, together with a grand stand, two bleachers and the necessary parking areas.

The major item in the development is the swimming pool, which is of rather unusual design. It is oval in shape and constructed of special asphaltic mixes. The water surface measures 254 ft. by 154 ft. along the axes. The sides slope uniformly from a broad convex lip, dropping 3 ft. in the first 40 ft., and 8 ft. in the next 27 ft. to form an area 120 ft. by 20 ft. with a depth of 11 ft. The capacity of the pool is one million gallons.

Reinforced concrete towers crowned with 10 ft. by 20 ft. concrete diving platforms stand on the pool floor at each end of the deep middle portion. The platforms protrude 2 ft. above the water. The spaces inside the supporting posts are enclosed completely with galvanized chain link fencing to prevent swimmers from becoming trapped beneath the platforms. Each platform is equipped with regulation single and multiple diving boards.

At the bottom of the pool there are eight 1½-inch weep holes fitted with screw covers. When the pool is emptied these covers can be removed immediately to off-set any back pressure from ground water. The ground water at this location is 18 in. above the pool bottom. Because of this it has been considered advisable to keep the pool permanently filled. The flat slope of the sides prevents damage from ice in winter.

Water enters the pool continuously through eight



Section through pool; flow design.

screened openings uniformly spaced around the sides 15 ft. in from the water edge. The tops of the openings are flush with the pool surface. The flow through each is distributed equally, and the amount is controlled by a meter gate in the adjacent bathhouse. The water level is maintained by an 8-in. cast iron pipe rising vertically under each of the diving platforms. The pool is emptied through a 10-in. cast iron pipe leading from the lowest point in the bottom into the nearby river.

Because very few swimming pools of this type ever have been designed, extreme care was taken in its construction. After the excavation was completed to the required contours, the convex lip was built up around the outside. This lip is 10 ft. wide and rises 3 ft. above the ground level. On the sub-grade, 18 in. of gravel sub-base then was spread and compacted. This base was stabilized with one gallon of MC-3 asphalt per sq. yd., on which was compacted 2¼ ins. of asphaltic concrete. At the breaks in contour of the pool wire mesh was embedded in the mix. On top of the asphaltic concrete course there was compacted ¾ in. of sheet asphalt, which was swept with lime-

The top course of asphaltic concrete was swept with limestone dust.

The completed pool before filling, with bathhouse at right.

Includes Asphalt Swimming Pool

A novel type of swimming pool features a well planned community recreation center. Design details and data are given.

stone dust and sealed with hot 85% penetration asphalt at a rate of 0.1 gal. per sq. yd. The finished surface finally was sanded, and sprayed with asphalt aluminum paint to obtain a light color similar to concrete.

The asphalt mixtures used were determined especially for the project, at the request of the Engineer, by F. C. Field, Chemist of the Asphalt Institute. The original contract had prescribed the Institute's standard specification (A-4) for sheet asphalt binder and surface courses. This specification, however, proved not to be adapted to the materials available. The following very dense mixes, therefore, were developed by Mr. Field:

Base Course (2¼" Asphaltic Concrete)

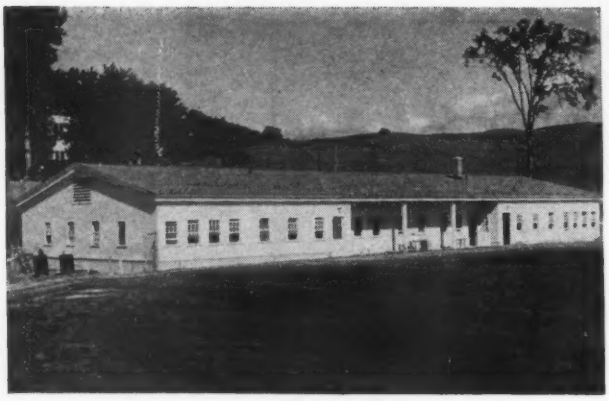
Granite aggregate 1- to ¼-inch	45.7%
Sand ¼-inch to 200-mesh	43.7%
Limestone dust filler	4.1%
Asphalt 85/100 penetration	6.5%

The formula produced a compressed mixture having a stability of 2600 lbs. at 140°F, and with voids of 2.8%.

Top Course (¾" Sheet Asphalt)

Sand ¼- to 200-mesh	81.5%
Limestone dust	10.0%
Asphalt 85/100 penetration	8.5%

Pool at left, football field, track and baseball fields and grandstand.



The bathhouse is 127 ft. long, 45 ft. wide.

This produced a compressed mixture with a stability of 3225 lbs. at 140°F and voids of 0.54%.

Although machine rolling of the asphalt mixes had been specified in the contract, this operation was omitted because of difficulties caused by the shape of the pool. Each course was laid in layers and each layer was thoroughly hand tamped while it still was hot. The base course consisted of three layers, and the top course of at least two. No material was dumped in place. Instead, it was piled nearby and immediately spread uniformly over the pool lining by shovellers.

In use, the pool is divided into three separate sections by floating life-lines anchored in the bottom. On the long side next to the bathhouse the enclosed area is about 200 ft. by 15 ft. Its water depth is not over 15 ins. and it will be used as a wading pool for small children. On the opposite long side is an area 225 ft. by 40 ft. with a maximum depth of 3 ft. This is for older children, and will be provided with a slide. The deep middle part of the pool, between the life-lines, is reserved for swimming and diving. The entire pool is enclosed by a six-foot chain link fence, with entrance provided through the adjacent bathhouse.

The bathhouse is a one story building 127 ft. by 45 ft. The long side fronts the pool, with a grass plot and asphalt walks between. It is built of shiplap on studding, unsheathed but painted inside and outside. The foundation and floor are concrete. The roof is of single span wood construction. There are fifty-four windows fitted with both screens and shutters. The entire building is equipped with electric lights, and from it are controlled ten flood lights for the pool and two flood lights for the parking area.

The bathhouse is divided into three main rooms. The center room is 45 ft. square and provided with counters and racks for basket storage. This room also serves as an administrative office. At each end of the building are dressing rooms 40 ft. by 45 ft. capable of accommodating 192 lockers. Each dressing room has 12 booths, 2 showers, 2 toilets and 2 lavatories. On the men's side is placed the hot water boiler for the entire building. On the ladies' side is a storage room. The corridors between the dressing rooms and the pool are fitted with showers and foot-baths through which bathers must pass. Entrance to the bathhouse is by way of the main room only, and access to the swimming pool is possible only through the bathhouse.

The water for both the swimming pool and the bathhouse is supplied by a 6-inch main connected directly to the city water system. A 4-inch pipe leads to the pool inlets, while the bathhouse fixtures are fed from a 1-inch pipe. All water entering the pool is metered for the purpose of controlling accurately the constant flow necessary to maintain the required freshness. Since the city water is chlorinated, it is believed that a constant flow through the pool will make further chlorination unnecessary. However, provision has been made for the future installation of recirculating and chlorination systems, if these should be required.

The sewage from the bathhouse will be carried to a 2500-gallon septic tank. From the tank it will go to a sewage bed composed of 188 ft. of 4-inch tile laid in gravel. This bed is connected in two places with the nearby river. Waste water from pool and bathhouse will flow directly into the river.

The swimming pool with its bathhouse, a children's playground and a 300-ft. by 100-ft. parking area occupy the southeast end of the eighteen-acre development. To the northwest are located the football field, baseball diamond, running track and another parking area. About five acres in all will be available for parking purposes. The ramps and sidewalk entrances to the field are designed so that children going to either the pool or the playground will not have to cross traffic lanes.

The football field is of regulation size with permanent goal posts. It runs east and west. When not required for football, it can be used for junior baseball. On the sub-grade of this field there was added three inches of topsoil and the entire area was sodded. The sub-soil throughout this locality consisted of about four feet of clay over gravel, and the finished grades of both the football and the baseball fields were designed to be more or less at the elevation of the gravel deposit.

The baseball field contains both the baseball diamond and the running track. The track surrounds the base lines, the closest distance between them being 15 feet behind home plate. From home plate to the track in center field is over four hundred feet. Directly back of home plate, with wings parallel to the first and third base lines, is a covered grandstand of steel and wood construction having a seating capacity of 1250 persons. Two portable wooden bleachers may be used either at the baseball or the football fields.

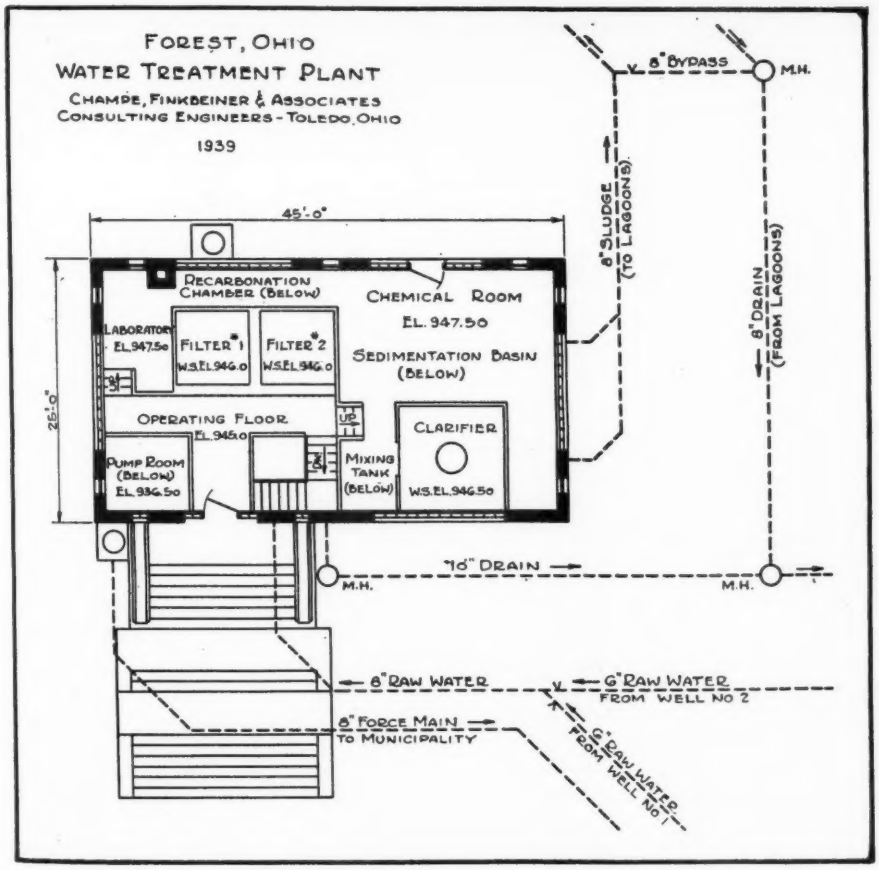
The running track is a quarter of a mile in length, with a straightaway for 100-yard events in front of the grandstand. The width of the track is 15 ft. except for the dash section which is 20 ft. The track is flush with the surface of the ground within the baseball foul lines, and outside of this area it is built above the normal ground. Twelve inches of gravel base, three inches of cinders, with a top of three inches of cinder-clay mixture were used in the track construction.

All surface water in the recreation field drains into the river. The different play areas are so graded that the water will find its way into broad, extremely shallow depressions which carry it away. Only the baseball diamond is actually level. Raw earth slopes or other bare areas will be completely seeded or sodded by next summer.

The success of the entire project was due largely to the cooperation of William F. Lawes, President of the Robie Construction Co., Inc., of Manchester, New Hampshire, who built the field, and to The Asphalt Institute which provided valuable assistance on the swimming pool through its Chief Engineer, Bernard Gray and Chemist Mr. Field. The total construction cost amounted to about $90,000 with property cost, legal and engineering fees, equipment and miscellaneous expenditures bringing the total to $100,000. The cost to the City of Montpelier was in the neighborhood of $55,000.

An Attractive Building for a Small Water Treatment Plant

The second in a series illustrating some modern and attractive water and sewage plant buildings



The water treatment plant building at Forest, Hardin County, Ohio. Champe, Finkbeiner & Associates were the architects. Built by G. H. Leach Co., DeGraff, O., at a cost of $26,172, complete, under PWA. Building is 25′ by 43′, with concrete beam and slab floors exposed, and 8-inch walls with two coats of bondex on the outside; cement finish inside. Photo courtesy of Portland Cement Association; floor plan courtesy of Champe, Finkbeiner & Associates.

This view shows the neat appearance of the grounds and the proximity of residences.

Attractive Sewage Treatment Plant Located at Edge of Village

By ELMER E. BARDWELL
Former Mayor

Careful design eliminates all possibility of objection and permits location at most economical site near residences and at important highway intersection.

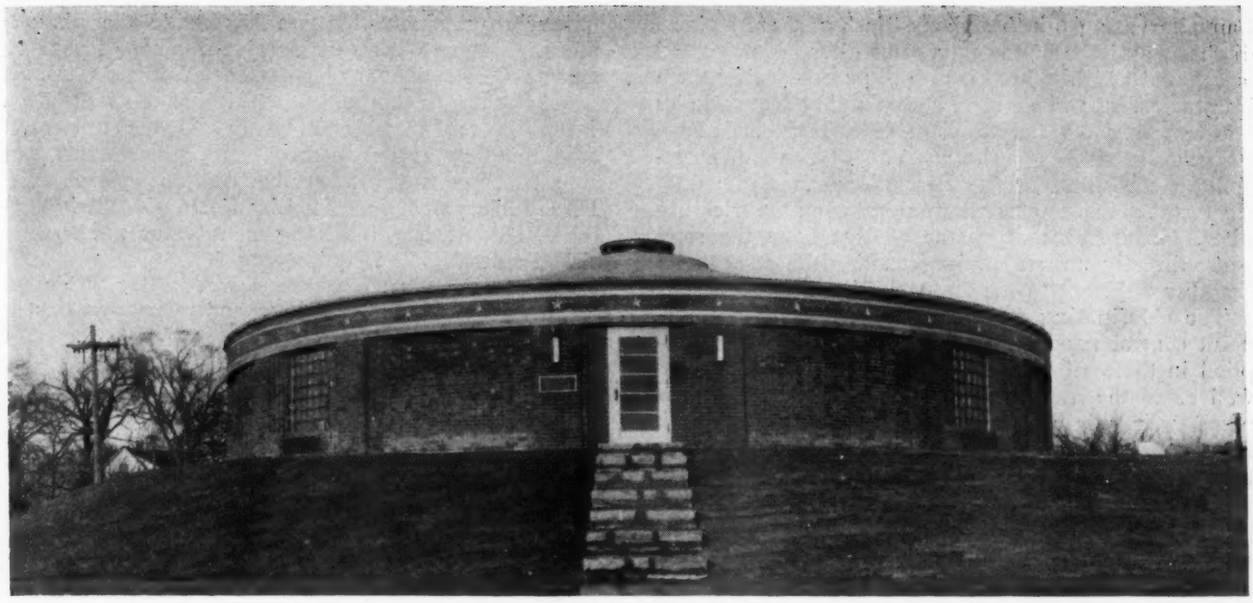
THE Village of Excelsior is a residential and summer resort community situated on rolling territory upon the shore of Minnesota's famed Lake Minnetonka. Its normal population is about 1,200 but the summer population is around 2,000. Until recently, it has had no sewerage facilities, but numerous privately installed sewers emptied at various places into the lake. The village takes its water supply through an intake some 800 ft. from shore and roughly opposite the center of the village. Although this water supply is conscientiously chlorinated, the health hazard and other esthetic considerations make this situation intolerable.

During 1939 there was completed and placed in operation a modern sewage collecting system consisting of about nine miles of sewers and a treatment plant. The peculiarly rough topography of the village and lack of available sites left little choice in the location of the treatment plant and outlet, if numerous sewage lift stations were to be avoided, and it was decided to build the plant in what is probably the most prominent location of any sewage treatment plant in the state. The site is a triangular plot of land about 400′ x 400′ at the intersection of two important highways and within a short distance of residences. It was necessary that the plant be both attractive in appearance and odorless. Because of the nearness of the village water supply intake to the sewage treatment plant, and the use of the lake shore for bathing and summer homes, it was necessary that it be designed to give unusually complete treatment, be easy to keep clean and give continually effective operation.

The treatment provided consists of primary sedimentation in a circular clarifier, followed by a trickling filter, secondary sedimentation, further treatment on sand filter beds, and final chlorination. In addition there is the safeguard provided by a swamp several acres in extent which intervenes between the treatment plant outlet and the point of final drainage into Lake Minnetonka.

The Plant Location

The main clarifier and pump house building, sandbeds and trickling filter are located only 50 ft. from one or the other of the much-travelled highways. The plant site originally was rough and in part used as a sand pit, but the relatively high elevation of some portions made it possible so to grade it as to provide different elevations for the several structures and thereby permit gravity operation of all units with the exception of the pumping required between the primary clarifier and the filter. The site has been terraced and landscaped. Additional adjoining village-owned property has been included in this grading and reserved for future possible additions of treatment units which would enable the capacity of the plant to be doubled. The present plant is designed on the basis of an average connected population, the year around, of at least



The trickling filter on the hill is fully enclosed to prevent objection.

1,500. It can readily handle a normal continuous flow of 100 gallons per minute and a maximum short time inflow rate of more than 210 gallons per minute.

By careful design of the sewerage system, it was possible to conduct the sewage from a considerable part of the village by gravity to the treatment plant, and to serve the remainder of the village by one principal lift station with a small auxiliary station for a group of low-lying cottages near the lake shore. The gravity sewer runs to the treatment plant from one direction, while the lifted sewage comes from the opposite, the flow from both combining in a manhole adjacent to the main building. This manhole provides an emergency by-pass which permits the entire sewage flow to be diverted from the plant directly into the swamp. From this entrance manhole a 12″ pipe normally conducts the incoming sewage to the clarifier and pump building nearby.

This main building of the plant is 26 ft. x 56 ft. in plan, built of brick and glass blocks, with a slate roof. This building houses the circular primary clarifier tank in one end; the main operating room is in the other end. The latter contains the two electrically driven centrifugal sewage pumps, the sludge pump, an oil-burning hot water boiler, the electrical control panel for the entire plant and a small gas-burning auxiliary heater. All these are below ground level. On a balcony at ground level in this room is a laboratory table with sink for carrying out simple operating tests, and the chlorinator. Ahead of the clarifier and located in the clarifier room is a comminutor with a by-pass through a stationary coarse screen for use when the comminutor may be out of commission. Its operation is controlled by a time-clock, as is that of the clarifier.

Principal features of this building are the light buff, glazed tile walls and waxed terra-cotta colored concrete floors; a dividing hallway and stairs between the two parts of the building aids in confining any possible odor to the clarifier room alone; and a ventilating fan in the clarifier room is placed near the ceiling in a false chimney. All these features have the purpose of facilitating the maintenance of cleanliness and odor control. The gas-burning heater provides for the burning of gas from the adjacent digester tank. Automatic temperature control of the digestion tank is provided by the oil-burning boiler.

The water level in the clarifier tank is about 10 feet below the ground surface, in order to permit the sewage to be clarified in advance of pumping onto the trickling filter, thereby saving an additional pumping operation.

The two horizontal centrifugal pumps lift the sewage from the primary clarifier through a force main to the trickling filter which is situated on the highest part of the land. Each of these pumps has a capacity of more than 100 g.p.m. They are automatically controlled so that in case of failure of one pump to handle the flow, the second will cut in. After being pumped to the filter, all further flow through the plant units is by gravity.

The trickling filter is 54 feet in diameter with an 8 foot depth of stone above the underdrains. The building is of brick which matches that of the clarifier and pump house. It has a solid bed of tile underdrains leading in parallel lines into an external collection gallery which surrounds one-half of the filter. For aerating and ventilating purposes there is located in an underground chamber at one end of the collecting gallery a motor driven blower, with an air intake duct above ground. This blower has a capacity of about 3000 cubic feet of free air per minute. The movement of this air is upwards through the filter rock, and its escape through the effluent pipe line is prevented by a water-sealed trap. Additional ventilation to the outside of the building is obtained through an exhaust fan in the center of the conical dome roof. This roof, entirely of concrete, was constructed by the Hewett method in which a rigid haunch is provided by means of circumferential steel placed around the haunch and stressed by means of turn-buckles after the entire dome was cast; these rods finally were covered with a three inch facing of concrete to protect them and to complete the architectural appearance of the building. Except near the springing line, the dome is only 3½ inches thick, has a rise of seven feet, and supports at its top an ornamental ventilator in which the exhaust ventilating fan is located. An interesting fact is that, as the circular rods were being stressed, accurate measurement showed that the center of the conical dome was forced upward slightly more than ⅛ of an inch.

After passing through the trickling filter the effluent flows by gravity to a nearby chamber which contains

four alternating 6-inch siphons. Each of these siphons discharges to one of the four sand filter beds situated on ground which is low enough to permit dosing them by gravity. The whole sand bed is eighty feet wide by 120 feet long, divided into four beds. These beds have 18 inches of small gravel topped by 18 inches of a specially graded filter sand. Their function is to give final treatment to the sewage after oxidation on the trickling filter. Underdrains carry the effluent from the sand beds directly to an underground chlorine contact chamber adjacent to the main building.

The chlorinating apparatus is fitted with a three-point control panel, thus enabling chlorine to be applied in the final contact chamber for sterilization, as well as to the incoming raw sewage for the purpose of odor control in the clarifier room and on the rock filter, and to the siphon chamber for odor control at the sand filter beds.

The sludge disposal system consists of the sludge pump already mentioned, an underground circular digester with stationary roof, and a glass-enclosed sludge drying bed. Sludge from the secondary settling tank located between the trickling filter and the dosing chamber, can be discharged by gravity to the inlet end of the primary clarifier, or it can be independently removed by means of the sludge pump. Normally the sludge from both clarifiers is removed from the center well of the primary tank. Special automatic decanting means are provided in both primary and secondary settling tanks for surface skimmings, which are also handled by the sludge pump. One of the discharge lines from the sludge pump runs to the digestion tank, another to the sludge drying bed. By manipulating the suction plug-valves, sludge can be pumped from either of the clarifiers or from the bottom of the digestion tank. By similar manipulation the sludge discharged can be run either into the top of the digester or to the sludge bed.

The secondary settling tank, interposed between the trickling filter and the dosing chamber has a steep-bottomed hopper for the collection of sludge. Skimming, when necessary, is done by hand but facilities are provided for decanting these skimmings into an opening, connected with the sludge discharge line, either to the suction end of the sludge pump or to the inlet end of the primary clarifier.

The final deodorized and disinfected effluent from the chlorinating tank is run through an outlet pipe just beneath the surface of the nearby swamp to a point about 200 feet distant from the main building. The clarified sewage becomes dispersed in this swamp, partly evaporates and may partly seep into the ground. Any overflow will run through the single existing swamp outlet into Lake Minnetonka.

Some 200 house connections to the sewers are already in use. Through the ventilating means provided at the highest points of the main building and of the trickling filter as well as through the use of chlorine for odor control, it has been found possible to operate at all times without objectionable odors either inside or outside of the plant.

The total cost of this plant, including overhead of all sorts, land, engineering and about 5000 cubic yards of dirt removal from the site was $74,300. The plant was designed by Druar and Milinowski, Consulting Engineers, of St. Paul, who are to be congratulated upon their economical solution of the triple problem of providing cleanliness and pleasing appearance, complete suppression of odor nuisance, and effective and convenient operation.

Theo Jensen Company, of St. Cloud, Minnesota, were the contractors. A visitors' book shows that the uniquely prominent location has made the plant a place of interest to a considerable number of persons, among them residents of a number of other states.

A feature of the plant which has elicited much favorable comment from visitors is the numerous bronze tablets affixed to the several plant structures, with inscriptions describing the functions of each unit. These tablets were furnished by Deaton-Kennedy Co., Joliet, Illinois. The following manufacturers also furnished materials and equipment:

Primary clarifier mechanism, Dorr Co. Inc., Chicago, Ill.; sewage pumps, sludge pump and rotary sewage distributor, Yeomans Bros. Co., Chicago, Ill.; quadruple automatic dosing siphons, Pacific Flush Tank Co., Chicago; plumbing, heating and ventilating, Reuben Anderson, St. Paul; oil burning boiler, Gar Wood Industries, Minneapolis; ventilating fans, America Blower Corporation, Detroit; ventilating blower, Buffalo Fan Corporation, Buffalo, N. Y.; piping, valves, fittings and unit heaters, Grinnell Co., Minneapolis; electric work, Hub Electric Co., Minneapolis; glass blocks, Pittsburg-Corning Corp.. Pittsburgh; brick and glazed tile, Twin City Brick Co., St. Paul; filter underdrain tile (Natco Unifilter Block), National Fireproofing Corporation, Pittsburgh; miscellaneous iron and metal work, Baker Iron Co., Minneapolis; slate roof, Geo. T. Warner Co., Minneapolis; waterproofing and floor finishing, Frank B. White Co., Minneapolis; comminutor, Chicago Pump Co.; metal doors, Builders Engineering Company of St. Paul; cork ceilings, Armstrong Cork Co., Minneapolis; flame traps, Vapor Recovery System, Compton, Calif.; chlorinating equipment, Wallace & Tiernan Co., Newark, N. J.; filter sand, Eau Claire Sand & Gravel Co., Eau Claire, Wis.

Owatonna's High-Capacity Filter Plant

Owatonna, Minn., placed in operation last winter a treatment plant of which the most interesting feature is high-rate filtration. Creamery waste constitutes fully 50% of the sewage and the amount fluctuates considerably at short intervals.

The plant, built last year with PWA aid, cost approximately $115,000. It contains an aerating grease remover; primary, secondary and double final clarifiers; primary and secondary high-capacity filters; duplicate digestion tanks; six sludge beds with one enclosed; together with a Parshall flume recording meter, six pumps, gas heating equipment, electrical control, chlorinating equipment and laboratory.

The clarifiers are equipped with motor-operated concentrators, and the filters with especially designed rotary distributors. Provision is made for recirculating the effluent. Heating coils are placed in the sludge bed building as well as in the first digestion tank.

To permit gravity flow through the entire plant, the primary clarifier and filter were placed on concrete columns about 12 feet high, and 15,000 cubic yards of filling placed under them and around the digestion tanks.

In spite of starting in mid-winter, the plant has given an average of 85% to 92% BOD reduction. The project has been under the general supervision of the city engineer, with M. E. Chamberlain, city engineer of Montevideo, as special consultant.

Effluent From Activated Secondary Tank

The secondary sedimentation tanks of the activated sludge plant of the Springfield, Ill., Sanitary District are provided with side and cross trough weirs as well as one at the outlet. It was found that the effluent, in rising to flow over the end weirs, carried with it considerable of the lighter sludge; and Carl C. Larson, chemist, last year raised these end weirs so as to cause all the effluent to leave by the others.

The Editor's Page

Making the City's Annual Report Do Its Duty

Annual reports are as common in May as in January; they bloom at any season, but too often they are an unattractive product, totally lacking in anything that will keep the reader's interest. Omitting mention of the fact that they are normally about a year old when they reach this office, what can be done to make them more effective?

A writer in the *Municipal Review of Canada* gives some worth-while advice. Any report, he says, should contain a confession of honest mistakes as well as a little bragging about what was done. It should also contain a discussion of the policies and plans governing the work that has been done or is contemplated. There should be a constant reiteration of the elementary principles governing the city work, even though it is necessary to use the same words every year. The citizenry is constantly changing, through immigration and by the addition of those coming to age. Discussions listed as being worth while include the reasons why a bond issue was chosen rather than a pay-as-you-go policy; why the fire department is an economy; why the 24-hour work of a police department makes its man-power look excessive; why a sewage disposal charge is a fair one; why special assessments; and why the city does not repair sewer services. There are plenty of other items that deserve a place in this list, and the alert city engineer, county engineer, water works or sewage superintendent should have no trouble in selecting subjects for elementary explanation.

Good Water for the Army in the Field

In speaking of the 1700 officers participating in the Army maneuvers at Fort Benning, Ga., Gen. Short, after reviewing the equipment essential for the modern streamlined division, said, in essence: "We have, in these exercises here at Fort Benning, for the first time in our Army's experience, good water being supplied to an entire Corps by our own water purification plants. We need no longer to be dependent on the old unsatisfactory methods for our water." Experience at Benning, as at other places, has shown the many advantages of the small and mobile filters as compared to the heavy and cumbersome ones of war time days. With the smaller units recently developed—many of which have been described in this magazine—greater mobility and a far better quality of water are possible. Instead of one filter unit to a division, there are four, and these together cost no more—if as much—as the one large unit.

This improvement is possible simply by utilizing the improved equipment that has been developed by progressive manufacturers in this field. That its use is satisfactory is especially pleasing to this writer because he has advocated for the past five years or more the substitution of such modern equipment for the provision of water for troops in the field; and he maintains that the aim should be to provide water as good as that which the soldiers are accustomed to at home. Under most conditions this can be done, without placing any undue load on the army machine.

Typhoid Reduction and What It Means to Sanitary Engineers

In Wisconsin, according to a recent bulletin of the State Board of Health, deaths from typhoid fever declined from 558 in 1910 to 6 in 1939. Assuming that each death represents ten cases, there were nearly 5600 cases in 1910 as against 53 in 1939. This reduction is probably quite typical of what has occurred in other States.

Thirty years ago the number of people who had suffered from typhoid fever was considerable, and these people, having recovered, were immune to the disease. Today there is a large crop of non-immunes, or susceptibles so that greater care than ever is necessary to prevent any chance of spread of the disease.

This means that there should be no relaxation in efforts to produce safe water and to treat sewage so adequately as to reduce to the minimum the opportunity for spread of disease. The inclination is to feel that, with typhoid (and other similar diseases) so greatly reduced, the danger is not so great. Actually it is greater, because there is more inflammable material at hand if the spark should drop. Better treatment methods and equipment, safe chlorination, and elimination of cross-connections and other danger points are needed now just as much as or more than in the past.

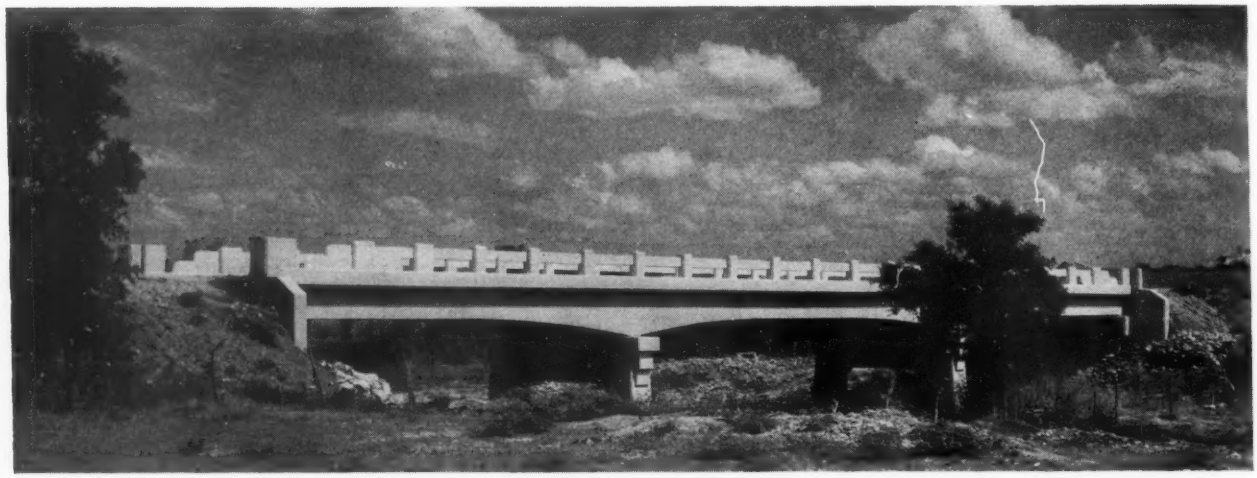
Municipal Tax Delinquencies Reach a Ten-Year Low

Steadily improving financial conditions of our cities is indicated by a recent Dun & Bradstreet report showing that municipal tax delinquency is now at the lowest point since 1930. In some cities, the mark is the best that has ever been attained. These data are based on a survey of 150 large cities, of which only twenty-three have been unable to equal or better the 1931 mark in percentages of current collections.

In other words, aside from the increased taxes that have been necessary because of conditions existing throughout the past ten years, our cities appear to be largely back to normal; and even the increased tax rates have been paid promptly. As a matter of fact we suspect that most cities are in a sounder financial condition than they were ten years ago, and this applies probably to an even greater extent to our villages. This is highly important because our cities, villages, towns and counties are big buyers of materials and equipment for highways, sewerage, water works, refuse and other utilities; and since tax delinquencies of the cities are also an accurate index of town and county conditions, it is an important indication that our counties and smaller administrative units are also in good shape.

Maintenance Savings on Modern Bridges Pay fo

A Texas county finds you can have new bridges at no extra cost; maintenance savings will pay for 1215 modern bridges in ten years or less.



Typical of the beautiful bridges replacing inadequate structures in Tarrant Co., Texas.

IN Tarrant County, Texas, of which Fort Worth is the principal city, there are 1,386 miles of highways with some 1,100 bridges and other drainage structures. For the construction and maintenance of highways and the maintenance of the bridge and drainage structures $380,000 per year has been available. Of the bridges and drainage structures, 1,039 were until recently of timber and most of them were in bad shape.

To provide for sound employment of as many as possible of the men on the WPA rolls in Tarrant County, and to improve and reduce maintenance costs on the county bridges, a constructive program of bridge replacement was developed.

From the records in the office of the County Engineer, Henry Cook, all of the old timber structures were located, their files picked out, and the maintenance costs on these structures were checked by the records of the county auditor for the preceding seven years. These records showed that during the preceding seven years, the average annual maintenance cost amounted to $50,000. These bridges represented chiefly the oldest type of structures, dating back to "horse and buggy" days and since that time maintained by piecemeal. These were antiquated, narrow, often poorly laid out as regards location, alinement and approaches, and generally deficient in strength.

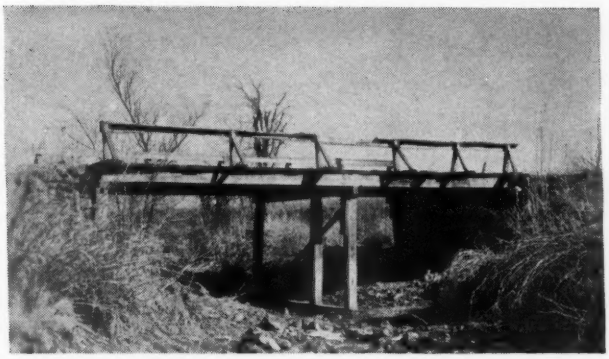
With the desire for speed in initiating the construction program, there was no time to estimate either required waterway area or costs on the basis of accurate instrumental surveys of each drainage area. Since the bridges in existence, by their continued existence, had demonstrated that their open span and waterway area were sufficient, initial design for cost estimating was based on these dimensions. State highway department standards were used for designing the new structures, so far as this was possible, and on these bases an estimate of the cost of the program was prepared. This estimate indicated that the replacement of these 1,039 antiquated bridges with modern structures would cost $1,360,000.

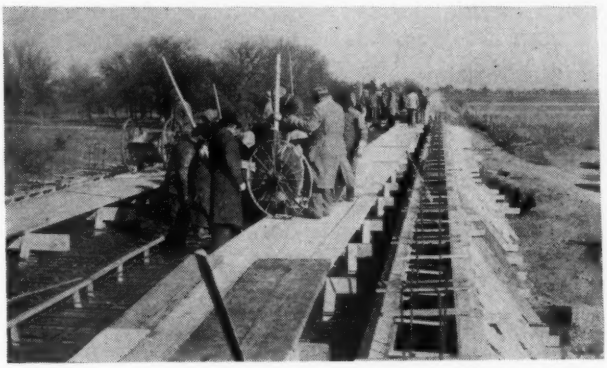
A cooperative project between the county and the Works Progress Administration was prepared to cover this expenditure. The county share was $403,000, which was to cover engineering, equipment, certain of the materials, supervision and overhead. To this the WPA added $957,000 to cover labor, which, it was estimated, would amount to 18,658 man months of work, and would employ nearly 1,600 men.

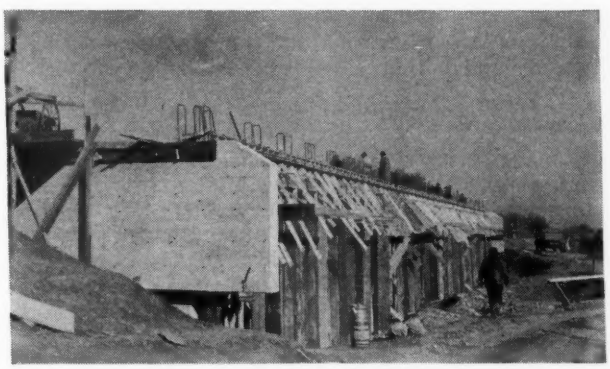
It should be stated here that the WPA funds were exhausted when 900 of the structures had been completed, due to changes in hours of work and wage rates. On the other hand the local funds remaining are

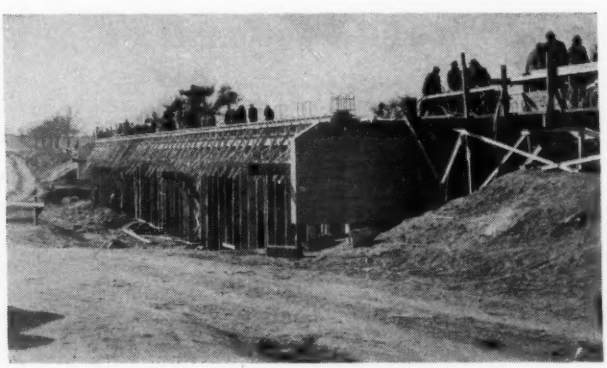
Structural details of a concrete bridge.

for Replacing Old Ones









sufficient to complete the county's share of the program. Therefore a supplementary project is being prepared to complete the construction of the remaining 139 structures in the original plan, and to improve stream channels and place riprap where needed.

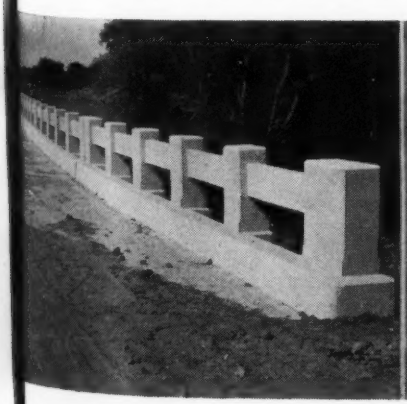
Also, so favorable has been the reaction to the work as carried on, another project is being prepared to replace 176 additional structures, including a number of dips and known inadequate bridges not covered in the first phase of the work. The purpose of this program is to provide a secondary sound work program on which the employment of 962 additional men will be possible. When completed, the county will have 1,215 excellent new bridges.

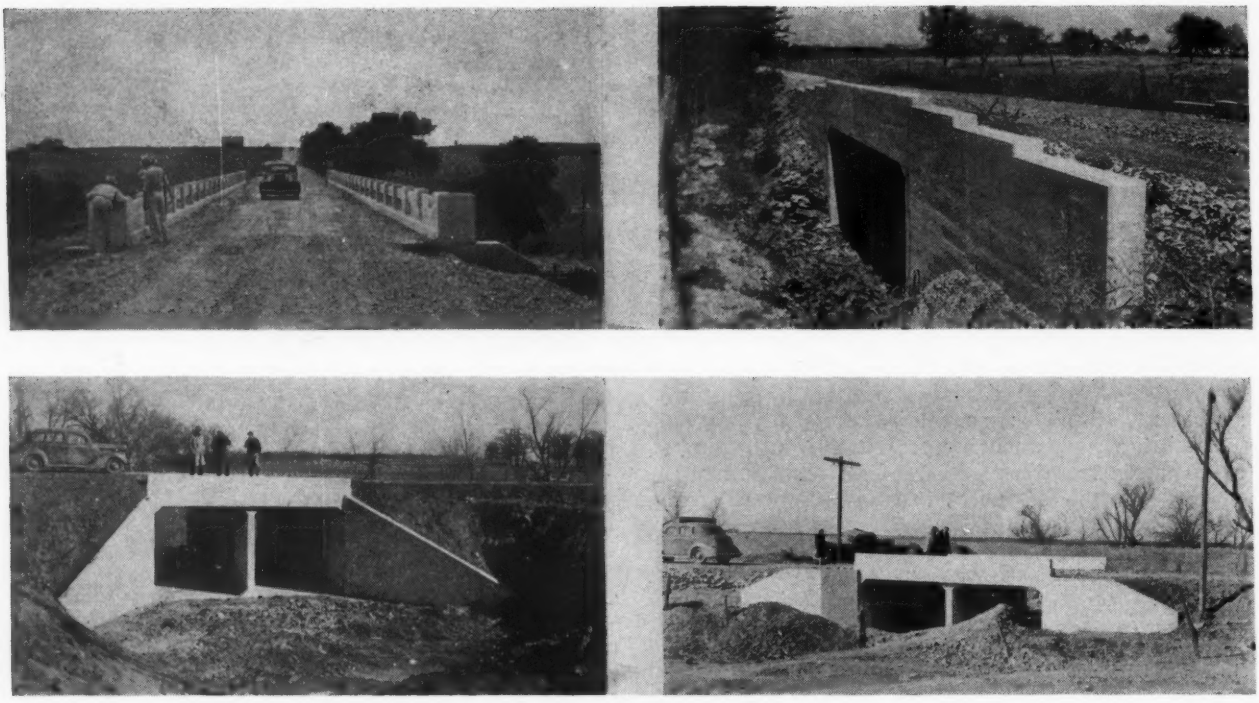
The money for the county share of the project—$403,000 — was raised by means of tax warrants against the regular road and bridge fund. Of the 250,000 people in Tarrant Co., not one objected to this procedure. The money will be repaid wholly from the savings in maintenance of the structures replaced. The work was begun in 1938, and already nearly $100,000 have been paid off. It is the intention to repay this borrowing at the average rate of $40,000 per year, which amount will be saved in maintenance.

In order that the work be on an efficient and economical basis, ample construction equipment was provided. The county purchased about $45,000 of equipment and assigned to the work other equipment already owned. Equipment purchased included 32 hydraulic dump trucks of 2-yd. capacity for hauling aggregates; 8 flat-bed trucks for hauling cement, forms, lumber, men and reinforcing steel; 8¾-ton pick-up trucks; and 4 concrete mixers, one 10S and three 7S. Among the equipment already owned by the county and assigned to the work were three shovel-crane units—a ¾-yd. and a ½-yd. Lorain and a ½-yd. Byers.

The needs for aggregate were met by an agreement with the owners of two sand and gravel pits advan-

Henry Cook, county engineer, right, below. Left, below, type of bridge rail. At the right above are some examples of old bridges.





These views illustrate typical construction details of some of the 900 new bridges already built.

tageously located. The owners agreed to set up adequate washing and screening plants; the county, through WPA employees, stripped the overburden, operated the plants, and produced, crushed, screened, washed and loaded the material. The pit owner maintained a representative on the job and was paid about 70 cents per yard for the materials and the use of his equipment. Sand and gravel were stockpiled to maintain the proper reserve of materials.

A central construction yard was located near the center of the county and on highways leading to the principal areas where the work was to be done. Truck hauling was supplemented by railroad hauling, a spur being run in to the yard. Material warehouses and work buildings are maintained here, as well as the county and WPA offices.

Timber is brought in to this plant and cut by electric saws and other modern equipment to proper shapes and forms for specific jobs. All forms are designed and built at this place, ready for use and are tagged for the individual job and sent out. Used forms are returned here for cleaning and reuse on other jobs. Reinforcing steel is bought in 60-ft. lengths, cut, bent, tagged for the particular job and location in that job and shipped out. This procedure results, in the case of reinforcing, in a saving of about 1¾ cents per pound as compared to buying the steel already cut and bent to proper lengths and slopes. In the first 900 bridges, 3,187,283 pounds of steel were cut, bent, tagged, sent out and placed.

Survey parties were in the field to run out the drainage areas of each watershed before final design, and also to give cross-sections of the stream beds at and near the road crossing. These data give the waterway area required for each structure, the flow line grade and the grade of the bridge and of the road approaches. On each bridge is placed a bronze plate showing the road number, the bridge number and the U. S. G. S. elevation of the plate. All steel, cement and concrete are tested by a local testing laboratory.

Most of the bridges built were single and multiple box culverts, Texas State Highway Department Standards. Larger structures were designed by Mr. Cook's staff. Where the cross-sectional area of waterway required was less than 8 sq. ft., commercially fabricated concrete pipe was used. Except in a few cases, all stuctures were designed for the Standard H-10 loading, and a Standard width of 24 feet was used.

Existing steel bridges were examined and specifications prepared for their repair or replacement. Those too narrow, too expensive to maintain or lacking in strength were replaced. If adequate in width and in good condition, they were refloored if this was desirable.

The work performed in building the 900 structures included the following: Pouring 24,992.76 cu. yds. of concrete; handling 74,000 cu. yds. of structural excavation; installing 7,360 lineal feet of concrete pipe in structures; installing 165,950 pounds of structural steel; placing 50,000 cubic yards of backfill; borrowing 45,000 cubic yards for improving approaches; constructing 650 detours; and hauling and placing 15,230 cu. yds. of road gravel for preparing approaches.

Very favorable public reaction has resulted from this program and newspaper support has been excellent. Cooperation between the County and the WPA has been highly satisfactory, resulting in efficient carrying out of the work.

This work, while under the general direction of County Judge Dave Miller and the County Commissioners—J. M. Scott, Joe C. Thannisch, Hugh Hightower and Frank Winters—has been directed and executed by Henry Cook, County Engineer. Assisting Mr. Cook are Ike Hart, Field and Designing Engineer, W. T. Crawford, Ass't Engineer of Design, and J. Matt Walker, Office Engineer. Operations of the WPA were under the general direction of Robert Colglazer and H. P. Drought of the State WPA office; Major Karl Wallace is local Director, with J. C. Douglas, Director of Operations; S. D. Steel is Area Engineer; and Jack Parmiter, WPA superintendent.

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How Counties Maintain Highway Equipment

A Survey by PUBLIC WORKS Magazine of Methods of Keeping Highway Equipment in Repair; and of Garage and Other Facilities

PROCEDURES in operation, maintenance and renewal of highway equipment were given by 790 counties in the annual survey by this magazine of county highway engineering progress, experiences and plans. To determine what means are ordinarily employed to decide when highway equipment needs repair, the following question was asked:

Does Operator Determine Need for Repair, Or Is This Done by Traveling Mechanic?

Replies indicated that it is predominantly the machine operator's job to determine when repairs are needed. The tabulation is as follows: Operators determine need, 536; mechanic determines need, 217; others determine need (maintenance supervisor or county engineer normally), 98. The total of these is 851, which is in excess of the replies received. This excess is accounted for by the fact that in some 50 counties the operator in consultation with someone else, usually the mechanic, determines the need for repairs.

On a percentage basis, the operator in 63.0% of the cases determines the need for repairs; the mechanic in 25.5% and others in 11.5%. This presupposes the selection of good operators, which is a sound practice. As a number of reports stated in essence: "We select good operators and make them responsible." On the other hand, such responsibility should not be considered in a too broad sense. The operator is normally held responsible for determining the presence and importance of defects that interfere with daily operation or which might cause greater damage to the equipment if permitted to go unrepaired. His responsibility is therefore one of details and not of a broad determination of the condition of the equipment; he reports his version of the need for repair to the shop foreman or mechanic for final decision.

There is some variation among the states. In Ohio, of 59 reports, the operator was held responsible in 34, the mechanic in 21 and others in 4. Ohio is a state in which highway work is well organized; as will be seen later a considerable number of counties maintain a mobile repair truck, and 92% of the counties reporting have a central servicing garage. There is therefore less responsibility on the operator than in more rural sections, as Minnesota, where out of 78 reports, the operator was held responsible in 59—76% of the cases. In Alabama, Florida, Georgia and other Southern states the mechanic or shop foreman is responsible in 60% of the counties.

Are Inspections of Equipment to Determine Need for Repairs Made Regularly?

Of 701 counties replying to this question, 486 or 69.4% do make regular inspections of equipment to determine its condition; 215 or 30.6% do not make such inspections.

It is difficult to determine a trend in this matter other than state policies or state conditions, though the factors of county organizations are usually apparent. For instance in the southern states, 41 report regular inspections and 14 do not. Kansas and Iowa, representing two middle west states, report 84 to 59 for inspection at regular intervals; Ohio 32 to 16; Illinois 34 to 11; Indiana 19 to 13; New Jersey and New York 27 to 3. In some northern states the necessity for snow removal usage, with the putting on and taking off of plow attachments, may influence practice and be responsible for semi-annual inspections.

Who Makes These Regular Inspections?

As would be expected because the engineer or superintendent is not a mechanic, he designates others to make these inspections. Here are the reports from 590 counties: The operators 142; the engineer or superintendent, 5; the mechanic in charge, 249; and others (generally the shop foreman) 194. Omitting the engineer or superintendent, since these replies were quite probably based on a technical responsibility for inspection, and grouping them with the "others," the operators appear to be responsible in somewhat less than one-quarter of the counties.

Again grouping replies as above, the southern states show only 7 counties out of 42 reporting where the operator is responsible for making these inspections. In Kansas and Iowa, the figures are 21 out of 101; Ohio 7 out of 41; New York and New Jersey 3 out of 24; Illinois 13 out of 38; and Minnesota, 24 out of 58.

Are Overhauls of Equipment Made Annually?

Yes, 425; No, 223; Oftener, 39. Total 687. The "No" should be taken with caution, for many follow the practice reported by F. D. Harlan, Jefferson County Engineer, Neb., who says, "No; our equipment is kept in condition all of the time."

As with the regularity of inspections, there is difficulty in determining any bases for practice. In Iowa, 37 counties overhaul annually, 3 more often, and 16 do not have annual overhauls; in Kansas, 30 overhaul annually, 2 oftener and 47 do not; Ohio has a score of 36-11-1; New Jersey and New York of 27-4-1; and a group of southern states 19-31-6.

To Buy or Not to Buy!

The basis for replacing or scrapping old equipment, as when worn out, repairs cost too much, operation is uneconomical or the equipment becomes obsolete was reported on by 801 counties, but there were a few counties classed under more than one heading.

Manufacturers will be glad to know that only 119 of the 801—a little less than 15%—actually wear out their equipment before replacing it. Practice along this line is quite uniform; in some states as many as 25% of the counties report that they wear out equipment; Oregon and West Virginia are the only states with any sizeable number of returns in which no county claimed this dubious economy.

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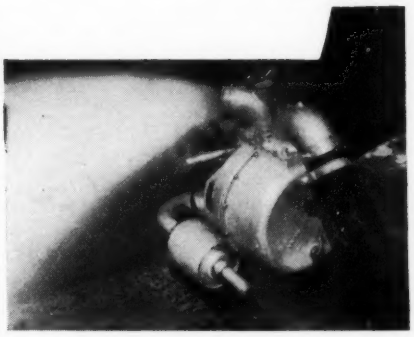

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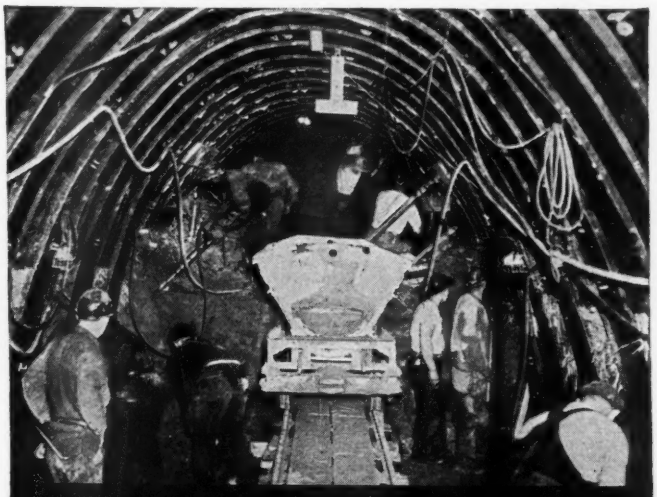

Tunneling for a large interceptor sewer 33 feet below a busy city street. The ARMCO Liner Plates helped save time and money.

Are you another engineer who is tired of the inconvenience and expense of trenching for large sewers and other underground structures?

Experience in many large cities proves that tunneling is the simple, effective answer. The work moves smoothly in any kind of weather and property owners are free from the nuisance and losses that go with torn-up streets. Once you try tunneling with ARMCO Liner Plates, you'll quickly find that unskilled labor can do the work safely and economically.

Tunneling with ARMCO Liner Plates is a practical, low-cost method of underground construction. The corrugated and flanged design brings safe strength without excessive weight. One man can easily handle the sturdy metal sections. Only structural wrenches are needed for assembly. Compact storage and reduced hauling, excavation and assembly costs are other prime benefits.

Try tunneling with ARMCO Liner Plates on that next job. You'll be pleasantly surprised at the time, money and inconvenience saved. Write us for complete details. ARMCO DRAINAGE PRODUCTS ASSOCIATION, 5052 Curtis St., Middletown, Ohio.

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TUNNEL LINER PLATES

STEEL ASSURES STRENGTH AND SAFETY

When repair costs become a burden, according to 235 counties—about 30% of those reporting—they go into the market for new equipment; almost the same number—240—replace equipment when it becomes obsolete; 207 base replacement on other reasons and if counties are like individuals no doubt one of these is available money. When the budget is short, the new equipment waits another year.

The most interesting item in this list is that of obsolescence; and we believe that it is one of the least recognized. Equipment is the basis around which work is organized; and it is also the tool by which raw materials are converted into usable structures, as highways. The cost of the raw materials greatly exceeds the cost of the equipment; therefore if the use of a better machine will produce a finished highway that is a little better and more durable, the purchase of the better machine is justified. Examples might be a heavier grader for road mix work; a modern distributor by which exact amounts of bituminous material can be spread; and a roller of the proper size for thorough compaction without crushing the aggregate.

In a future questionnaire we shall consider the advisability of going more fully into these factors.

Central Garages and Mobile Repair Trucks

Nearly every county has a central garage; 610 so reported; a few said they did not have one or more; and the remainder left the question unanswered. Generally, an unanswered question is negative. Assuming 790 counties, the percentage of those with central garage and repair facilities is 77.2%.

Perhaps even more interesting is the maintenance of a mobile repair truck to go out into the field and do all but major repairs on equipment, much of which is slow moving and difficult to bring to a garage—rollers, heavy tractors and motor maintainers. A total of 187 counties reported having such mobile repair units.

Of 148 counties in Iowa and Kansas which replied to the questionnaire, 135 reported having central garages; and 54 had mobile repair units. In a group of southern states, with 53 counties reporting, 35 had central garages and 19 mobile repair trucks. Of 40 New York and New Jersey counties, 31 counties had central garages and 14 had repair trucks. In Ohio, 50 counties reporting, 47 had central garages and 13 had repair trucks; in 46 Michigan counties, there were 46 central garages and 6 repair trucks.

Comments by County Officials

In Burlington County, N. J., F. L. Brannin, County Engineer, and L. A. MacFarland, County Road Supervisor, a traveling mechanic is employed; he contacts the operators each day. The mechanic, who operates in a truck fully equipped for small jobs, determines what repairs are needed and where. Equipment is overhauled when needed but is cleaned and painted annually in December and January. A unit cost record is kept by the chief mechanic and this largely determines the scrapping or replacement.

C. E. Habiger, County Commissioner, Colfax County, N. Mex., maintains a constant check on road equipment. As to scrapping, he says: "It is usually junk when we get through with it, but we trade it in on new equipment and with the competitive bidding required by law in this state, we sometimes get a good price for it."

Oswego County, N. Y., F. DeWitt Odell, County Superintendent, says that each fall all equipment is completely overhauled in the county garage to make it ready for snow removal; scrapping or replacement is decided on basis of complete cost records. H. E. Stensith, Ramsey County Surveyor, N. D., believes a machine should be replaced after 10,000 to 12,000 hours of operation.

Allan Slade, Franklin County Engineer, Ohio, states that their practice is to replace a certain amount of equipment each year, calculated on average replacement every six years. Rodney Whitt, Lawrence County Engineer, Ohio, reports that when the cost of repairs reach 8% per month of the first cost, the equipment is scrapped. An operator's weekly report blank was sent us by M. A. Gantz, Miami County Engineer, Ohio. P. M. Morse, Lane County Engineer, Ore., scraps equipment when repairs begin to cost more than the earning power of the machine. Marion County, Ore., N. C. Hubbs, Engineer, charges an hourly rental against each piece of equipment each day, thus building up a revolving fund to replace with new equipment.

Most of the equipment used by Davison County, S. D., Robert Hynes, Highway Superintendent, starts from the county shop each morning and condition is checked there. This county has a gas truck to supply all units and the gas truck operator is a mechanic. Davidson County, Tenn., J. C. Akers, County Highway Engineer, replaces a machine when its maintenance cost begins to approach the rental charge or when other equipment produced makes it obsolete.

A Texas County Engineer says that replacement of equipment is determined by the ability of the salesman to sell new equipment. Arlington County, Va., C. L. Kinnier, Engineer, also charges rentals. Jefferson County, Wash., W. A. Bugge, Engineer, maintains accurate cost data on equipment; so does Chippewa County, Wis., W. H. Taylor, Engineer; and St. Croix County, H. B. Olsen, Commissioner; and the same is true of many other places. The general rule is that when it becomes too costly to keep a machine it is replaced.

Some two hundred other interesting comments were made which, in this article, it is not possible to include; perhaps in a later issue they also will be covered.

Two Miles a Week of Bituminous Stabilization With WPA

In a discussion at the Purdue Road School, Ralph Witt, County Road Supervisor of St. Joseph Co., Ind., described bituminous stabilization work carried on in conjunction with WPA, as follows:

We reconstructed 23 miles of gravel roads last year, the county furnishing equipment and some material and WPA the remainder. This road runs east and west across the county, seven miles south of South Bend. It crosses six north and south paved highways. No material was added to the road bed; WPA built the berms, ditches and back slope; we built the road surface.

For this work we used three power graders, one multiple blade maintainer, one 10-ton smooth wheeled roller, seven gravel trucks, and a chip spreader. Our power graders are equipped with scarifier and windrow eliminators, the latter being valuable in laying out the base. This project was completed in less than three months, with an average of a mile every three days.

The road surface was 20 feet wide and the depth of base about 6 inches. The gravel roadbed was scarified and the loosened material turned with the graders to break up the lumps of fines. Then it was spread over

the roadbed and one half of the tar was applied. This tar and half of the loosened material was bladed back into a windrow. Then the balance of the tar was applied to the rest of the loosened material and windrowed. By repeated turning with the large blades, a peculiar mixing is accomplished. Only the fines are coated. Water must be present. A moisture content of 10% will give a rapid mix although considerable of this moisture must leave the mix before laying out the base. When thoroughly mixed, the base was spread. Partial compaction was accomplished by the mixing equipment, and more compaction by the smooth wheel roller.

As soon as the base was rolled, a "tack coat" was applied. We used 0.8 gallon of TM—2 in the base and 0.2 gallon TM—2 for the tack coat. A light spread of pea gravel was placed over this tack coat. Two days later we rolled it again. The road was open to traffic at all times, and traffic completed compaction. A seal of .3 gallon of TH was applied with sufficient cover of pea gravel. The sealed surface was well rolled completing the road. In addition to this project, we completed 11 miles of oil mat and sealed four miles of old black top road surface.

Here I wish to add a good word for WPA. If properly treated they can be a real asset. Too many counties have taken the attitude of "take all and give nothing."

Moving a Water Main Under Pressure

Lowering, raising or otherwise changing the position of cast iron water mains without putting them out of service is frequently found to be desirable, and many cities have carried out the operation successfully, variations in procedure being developed in many cases. Pensacola, Florida, recently moved approximately a mile of 6″ pipe from 2 to 15 ft. laterally and an average of 2 ft. vertically, including remaking six connections with pipe 6″ to 12″ diameter and inserting three valves. The pipe was bell and spigot, lead joint, laid prior to 1909.

In doing this the contractor, the Frank Construction Co. of Daytona Beach, Florida, first uncovered about 1000 ft. of pipe, cut all service connections and reconnected the services by means of garden hose. Cross connections were cut and the ends closed with mechanical plugs or caps, water pressure being off only during the actual time of cutting and plugging all openings. The pipe was then raised vertically to the ground surface level and supported by planks across the ditch, which was then backfilled.

A ditch was then dug in the new location to receive the pipe, and the pipe moved over onto planks spanning this trench. In moving the pipe, 20 men were used, a man at each joint, who used poles to pry the pipe over. After it had been moved 3 ft. for the entire length, the men returned to points where more movement was needed and repeated the operation.

Then, beginning at one end and using an A frame and winch, the pipe was lowered a length at a time until it rested on trench bottom or supported itself. When all the pipe had been lowered to the bottom of the trench, all joints were recaulked, although there was practically no leakage. The services, shortened or lengthened as necessary, were then reconnected.

Where the water pipe had to be lowered below cast iron gas mains that crossed it, a short section of the latter was plugged off and cut out, and replaced by use of sleeves after the pipe had been lowered.

BUILDING THIS SLUICEWAY was no cinch

Ease of handling made it simple to erect this Multi Plate structure above the water. Here you see the pipe being lowered by means of 18-foot screws attached to the top of the plates.

THE PROBLEM: To build a sluiceway as the first step in replacing a wooden bridge with a permanent earth causeway from island to mainland at the site of the 1933 World's Fair. Installation of the 327 foot structure was complicated by the need for placing it in 30 feet of water.

THE SOLUTION: Experienced engineers decided on ARMCO Multi Plate Pipe as the safe, practical answer. Their choice was based on the great structural strength of the corrugated metal plates and on the economy and ease with which they could be erected.

The easily handled Multi Plate sections were assembled on a trestle above water and lowered to a prepared bed. Then 28 feet of hydraulic fill was placed over the pipe.

While this installation is unusual, ARMCO Multi Plate brings similar benefits under ordinary conditions. Use it for stream enclosures, bridges, large sewers or special drainage structures. Write for full information. ARMCO DRAINAGE PRODUCTS ASSOCIATION, 5050 Curtis St., Middletown, Ohio.

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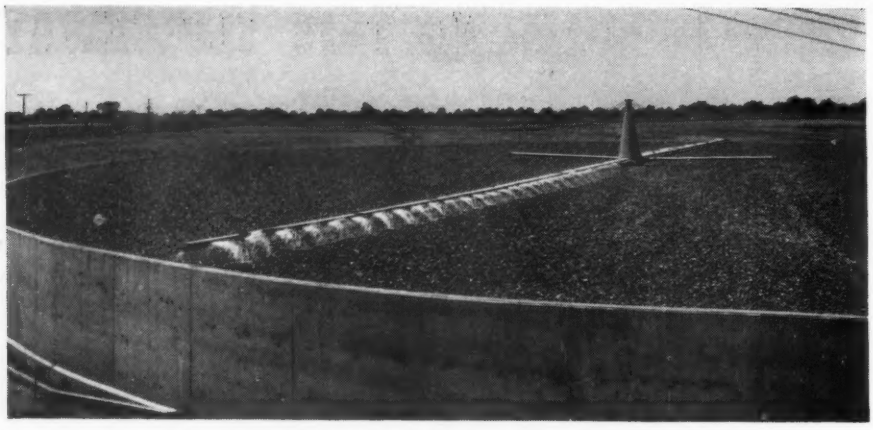


Dorr distributor at Visalia, Calif., 4 mgd.

The fourth and last in a series of articles covering materials and equipment for design, construction and operation of trickling filter.

Trickling Filter Equipment and Operation

EQUIPMENT for a trickling filter comprises that for regulating the dosage to each of the filter beds and for distributing the sewage onto the bed. The first of these purposes is served by dosing tanks, the second by distributors.

There are two general types of distributors now in general use — fixed and movable. Of the former, nozzles discharging vertically upward are by far the most common. Others, such as lath distributors, have been tried from time to time. A recent modification with fixed nozzle and revolving disc has been designed for filters 30 ft. or less in diameter.

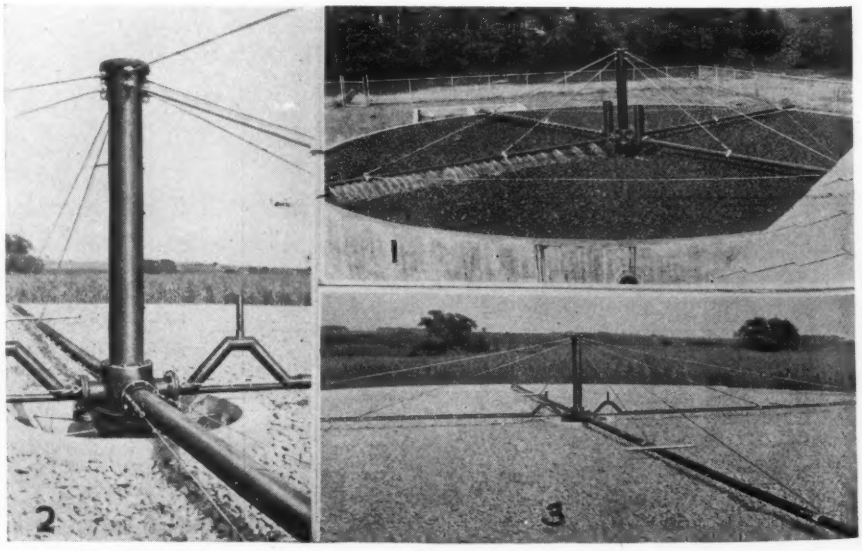
Movable distributors are of two general classes—the rotary, having arms that revolve around a central vertical cylinder; and the rectilinear, in which the distributor moves back and forth from end to end of a rectangular bed.

Rotary Distributors:

A rotary distributor consists of two or more horizontal pipe arms attached to a central vertical cylinder which rotates with them. Each arm contains a number of holes through which the sewage flows onto the bed after entering the central cylinder and attached arms through an underground pipe. Most rotary distributors are revolved by the reaction of the discharge, all the openings being on the same side of all the arms. If the amount of discharge at any time becomes so small that the reaction is insufficient to overcome the friction of the revolving apparatus, the arms will stand still and the sewage flow continuously on a small area immediately under each arm, which should be avoided. Except for this, however, the arms revolve continuously, and, although the discharge onto each unit area of the bed is intermittent, the interval between discharges is only one-fourth (for a 4-arm distributor) that required for a complete revolution of the distributor; and it is theoretically possible to so design the nozzles and space them on the arms as to secure practically uniform distribution over the entire bed.

Rotation is effected by heads varying, for standard-rate filters, from 12″ to 24″, depending on the friction in the revolving apparatus, which in turn is affected chiefly by design and construction details but also by temperature, ice, etc. If there is a possibility that the head may fall below this because of insufficient sewage (as at night), a dosing tank and siphon should be used which will shut off the flow before it reaches such minimum, and restore it after the tank has filled; or effluent can be pumped back to the inlet at a rate varied to keep the flow uniform. (For high-rate filters, higher heads may be used giving more rapid rotation.)

Most rotary distributors will handle up to 2½ times their minimum. Two makes can be obtained, each of which has 4 arms, only two of which are in use until the flow exceeds 2½ times the minimum, when the excess overflows a weir or similar device into the other two arms; which then permits operation at 5 times the minimum without increasing the head. Another make produces the same effect by combining two



PFT "double flow" rotary distributor installations.

channels in the same arm, each with its own nozzles.

One firm makes a rotary distributor that does not operate by reaction, but the arms are revolved by a motor mounted on top of the central cylinder; and the discharge is through holes in the bottom of the arms, which discharge onto a splash plate continuous from end to end of the arm.

In general, all reaction distributors are much the same, differing chiefly in details of construction—materials used, strength, stability, bearings, nozzles on the arms, etc. All makes have removable caps or valves on the ends of the arms so that these can be drained out and cleaned. Each firm has its own type or types of nozzles, the aim being to obtain a wide, thin film or spray. All provide a mercury seal between the base and the revolving cylinder that carries the arms (mercury is used because it does not freeze) and ball bearings at top and bottom of the outside cylinder.

Rotary distributors are made for almost any desired diameter of bed up to 150 ft., each serving an entire circular bed. Longer arms would generally be undesirable because of difficulties of construction, lack of stiffness, high rates of nozzle discharge necessary at the ends of the arms, etc. The last and intervals between dosing can be reduced by increasing the number of arms. Chiefly to give high and more nearly continuous dosing for "Aerofilters," a distributor is made having four arms at the center, each of which bifurcates into two branches, giving 8 arms to serve the outer part of the filter. This distributor is said to apply at the rate of 30 mgad, making 6 rpm, or 48 contacts a minute at the outer part of the bed.

For small filters, receiving from 1,000 to 15,820 gallons a day, the "Simplette" sprinkler has recently been placed on the market. In this the entering sewage revolves a water wheel which, through bevel gear, revolves a trough which spans the circular filter and is supported at the center by a channel beam that rests on the outer walls. The sewage, after driving the water wheel, flows into the channel beam, which serves as a trough to convey it to the center of the bed, where it is discharged into the distributing trough; from which it flows onto the bed through a number of V-notch weirs. It operates with a minimum head of 1′ 10½″.

In all rotary distributors (except the "Simplette") a central pillar supports the revolving cylinder and connected arms and is mounted on a central concrete base and generally surrounded by a well that gives access to the mechanism and the drainage system. The pipe that brings sewage to the distributor passes through the filter stone, or in some cases under the filter bottom, and connects with the central pillar near its base. A small washout pipe is generally connected at the same point, provided with a valve and discharging into the central well or the drainage system, or is carried through the bed and the outer wall.

Dosing tanks are designed to shut off the supply to the distributor when it falls below that necessary to revolve the arms, and to renew it when the tank fills above a certain point; which point should be at least sufficiently high to insure the distributor starting from no motion. This head and the size of tank should also be such that the distributor will revolve for at least several minutes before the flow is shut off again. Yeomans recommends a depth of tank of 2′ 6″ and a capacity of about one minute's normal discharge with a depth of 1½ ft. For example, for a 1.25 mgd capacity, the tank would have about 80 sq. ft. area. Each maximum head, and to a certain extent each make of distributor, calls for special design of tank; instructions for which will be furnished by the manufacturer.

In designing a filter for a rotary distributor, the area desired is determined as already described. Add to this the area of the well in the center of the bed; then determine the diameter of a circle having this area. Select for the bed diameter the next largest multiple of 10, since the distributors are usually made only of such sizes. Having decided on the make of distributor, obtain from the manufacturer detail plans for constructing the foundation for the central pillar, depth and diameter of feed pipe, and any other details necessary.

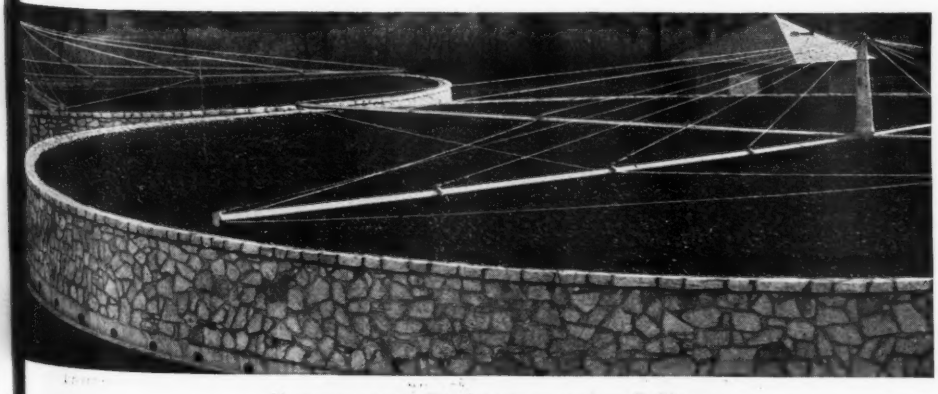
Another type of distributor, designed for round tanks 30 ft. or less in diameter, consists of a nozzle discharging vertically upward onto a disc from one to two feet in diameter which is revolved rapidly by motor and spreads the sewage as a spray uniformly over the entire bed; both nozzle and disc being designed of size and shape especially to effect this.

Rectilinear distributors are made by one company in this country. They consist of a trough which extends across a rectangular filter bed, each end carried on a truck, which trough travels from end to end of the bed, forward and back, continuously discharging the sewage. A channel paralleling one side of the filter bed receives the sewage to be distributed, and a siphon attached to the trough siphons the sewage continuously from channel to trough. From the trough the sewage flows, through V-notches in one side, onto a horizontal spreader plate under each notch and from these into an angle, from the edge of which it flows in a continuous sheet onto the bed. Power for moving the trough is taken from an overhead trolley wire.

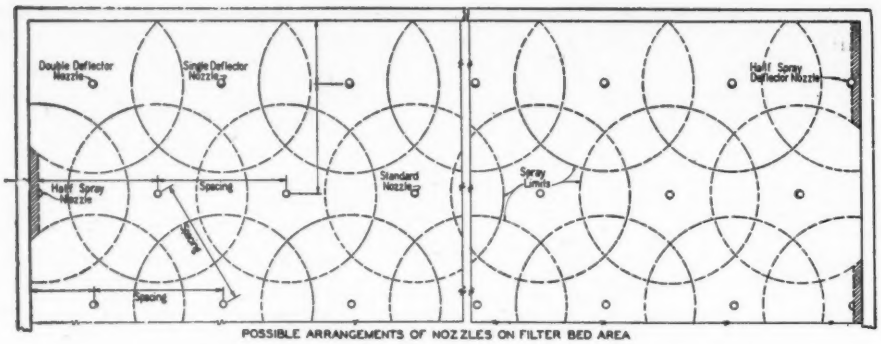
Nozzle Distributors:

Stationary nozzles were used universally in this country until within the last few years, and they are still being installed in a number of new plants, although for the past year or two the majority of new installations have employed the rotary distributor. The Pacific Flush Tank Co., for years practically the only firm that furnished equipment for fixed nozzle sprinkling, and which makes rotary distributors also, believes that "it is desirable to apply sewage to filters by means of equipment having no moving parts. . . . Fixed nozzle apparatus is rugged in construction, makes use of materials that are subject to little or no corrosion, and does not require extreme refinement in manufacturing and installation as does equipment having moving parts." Offsetting advantages of the rotary distributors are more uniform distribution and shorter intervals between dosing each unit area of filter. In general it will be found that fixed nozzles are cheaper for a small bed, rotary distributor for a large area. The latter will operate under less head than the former.

Nozzles normally throw a spray in an annular ring, and by causing the



Yeomans rotary distributors on rock wall filters.



Arrangement of PFT deflector nozzles for maximum utilization of filter area.

head to vary gradually, the diameter of this ring is made to increase or decrease so that the spray, in one cycle, covers the entire area inside the ring of greatest diameter. This variation of head is effected by the dosing tank.

No area can be covered by a number of circles unless these overlap, and it therefore is impossible to make a design using circular sprays that will give uniform distribution over the entire bed. (Nozzles have been designed to cover octagonal areas but have not proved practical.) It is found that the best distribution is obtained by placing the nozzles on the apices of equilateral triangles, and so spaced as to provide the optimum overlap at the maximum head. (This head is often fixed by the topography of the plant site and relative elevations of the incoming sewage and the outlet.) This would leave areas between circles around the edge of the bed that received no spray, and to meet this difficulty P.F.T. deflector nozzles are provided that throw spray over only half a circle or other larger segments.

Of the total head from elevation of sewage in dosing tank when full to that of the nozzles (practically the surface of the bed), about 25% is lost in dosing tank and distribution system, the remaining—the "net head"—being effective for throwing the spray. This net head may be anything from 4 to 10 ft. The greater this head the greater may be the distance between nozzles and consequently the fewer of them required. With a 4 ft. net head, ⅞" nozzles can be spaced 9 ft., 1" nozzles 10 ft. With an 8 ft. net head the former can be spaced 15 ft., the latter 16 ft. A table giving these dimensions for all practicable heads is furnished by the manufacturer of the nozzles. The "net area" covered by each nozzle is that of a hexagon with the nozzle spacing as the diameter of the inscribed circle. Dividing this area into that of the entire bed (less the undosed area around the edge) gives the number of nozzles required. If deflector nozzles are used, the number must of course be increased accordingly; two half-spray nozzles being equivalent to one standard nozzle. The dimensions of the bed should then be adjusted to permit the spacing of the nozzles as designated. (See also under "Distribution System.")

To obtain intermittent operation with a single dosing tank, the minimum rate of dsicharge of the nozzles (that at the end of a dosing cycle) must exceed the maximum inflow rate. The minimum head (that causing the minimum discharge before the flow stops) may be between 1 and 2½ ft.—1½ ft. is considered the most desirable. If this minimum rate per nozzle times the number of nozzles is less than the maximum inflow rate to the bed, then larger nozzles should be used, or more of them. The standard size of nozzles is ⅞", but they are also made in ¾" and 1" sizes.

Dosing Tanks:

A dosing tank is one which receives the liquid to be sprayed until it is filled, then discharges it at a predetermined rate so varying that, as the head on the nozzle falls and the diameter of the ring of spray lessens, the dose per square foot remains constant; and when the head reaches the minimum desirable — generally about 1½ ft.—ceases to discharge and fills again. While the tank is filling there is no discharge from the nozzles. The essential features are the shape and size of tank, and the siphon by which intermittent discharge is obtained. If the siphon is too large relative to the number of nozzles it feeds, the dosing tank loss is increased; if it is too small, the siphon loss is increased. In general, the theoretical diameter of siphon required for ⅞" nozzles is the square root of twice the number of nozzles.

The designing of a dosing tank is somewhat complicated. Full instructions can be obtained from the Pacific Flush Tank Co.; or the company will furnish a design if given all the necessary data.

If there is a single dosing tank, sewage continues to flow into it while it is discharging, such inflow rate varying widely from hour to hour in some cases. This interferes with proper distribution by the nozzles. Better results are obtained by using twin dosing tanks, one filling while the other is discharging.

Twin dosing tanks are built in pairs, and at the inlet end of each tank is an

Column and arms of Dorrco 2-level distributor. Maximum capacity 63 mgd. Arms are separated into two levels by horizontal plate.

automatic air lock which shuts off the inflow when its tank is filled, the air lock in the other tank being released at the same time. Both tanks may discharge into a common distribution main which serves the entire bed, thus practically doubling the number of dosing periods; or the bed may be divided into halves, each served by a separate tank.

Whatever kind or size of tank is used, the rate at which the nozzles actually discharge and the duration of discharge depend upon the maximum and minimum heads on the nozzles; and since the minimum rate exceeds the maximum rate of inflow of sewage, it takes much longer for a tank to fill than to empty, and therefore actual dosing occurs during much less than half the time with a single dosing tank, and is far from continuous when twin tanks are used.

Distribution System:

The sewage is carried from dosing tank to nozzles through a system of pipes. This commonly consists of a main through the center of the bed, and branches leading both ways from it at right angles and extending to the ends of the bed, the nozzles being attached to these branches.

These pipes may be located near the bottom of the bed with a riser to the surface for each nozzle; or they may be laid directly on the filter stone with their tops at the bed surface, the nozzles being screwed directly into holes tapped in the tops of the laterals. The latter location eliminates riser pipes, which, in addition to their cost, are more likely to freeze than the larger pipes on the surface, and more difficult to thaw.

The location of the branches of the distribution system is fixed by the nozzle spacing, the distance between branches being the altitude of the equilateral triangles at whose apices the nozzles are placed. Their sizes are calculated to give the least loss of head at reasonable cost, if the total head available is limited. If, however, there is abundance of head, a saving can be made by using smaller pipe. Generally no size smaller than 4″ or even 6″ is used, for it is difficult to tap smaller sizes for nozzles; they are more apt to freeze and are more difficult to keep clean; while friction head increases rapidly as the size falls below 6″.

It is estimated that, if head is limited (say total head less than 10 ft.), the loss in the distribution system should not exceed 8% or 9% of the total. The lost head is greatest for the nozzle on the end of the branch furthest from the dosing tank (assuming a rectangular bed); but as the branches are all approximately equal in length and in number of nozzles carried, the difference in heads on nozzles is minimized by making the main amply large; also any saving in head in this one pipe permits increasing it in all the branches (that is, using smaller pipe at less cost). In some cases the pipes are decreased in size as the number of nozzles beyond to be fed decreases; but as stock sizes of pipe must be used, this would seem to be not worth while except for very large beds.

The friction loss in the pipe is determined as for water mains; using the coefficient for new pipe (cast iron is commonly used), for the system should be accessible throughout for cleaning and kept clean. The volume to be carried at any point is a multiple of the number of nozzles to be fed beyond that point, and the rate of discharge of each nozzle at maximum net head (approximately 75% of the total head). This rate for ⅞″ nozzles ranges from about 16 gpm for 4 ft. net head to 22 gpm for 7.5 ft., varying as the square root of the head. For 1″ nozzles the rates are 40% greater. The friction loss in dosing tank and equipment usually is estimated to be about 16% or 17% of the total head.

The distribution system can be made of the lightest pipe that is thick enough to be tapped for nozzles, since the internal pressure is negligible. It should be laid truly level so that heads on the

NATCO UNIFILTER TILE

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Natco Unifilter Blocks in use in Sewage Disposal Plant at Lancaster, Ohio. Burgess and Niple, Engineers, and Couse and Saunders, Contractors.

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nozzles will be equal, and in straight lines so that rods can be run completely through for cleaning; and for this purpose, and to permit draining, the ends should be closed with removable plugs or caps, a valve or a shear gate. Threaded plugs leaded in can be used with bell ends. Caps provided with shear gates can be obtained. A small cock is sometimes placed on the under side of the end of each branch, to be left open at night, when flow is small, when there is danger of freezing.

Operation:

When functioning perfectly, a trickling filter needs no attention except the regular daily taking of samples. It is assumed that the dosing tank has been designed and constructed to give the most effective distribution, but as the volume of sewage increases, the interval between flushes will decrease. If, after a flush, the nozzles continue to trickle, this may be caused by a rate of sewage flow greater than the nozzle discharge at minimum head, indicating the necessity for adding another filter bed, meantime by-passing part of the sewage during periods of maximum flow, or other device. But the trickling may be caused by trouble with the dosing equipment — usually an air leak. This should be located and remedied, usually by tightening a joint or replacing with new pipe.

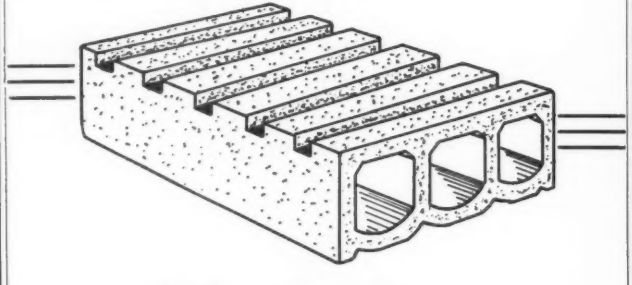
In most plants, more or less grease reaches the dosing tank and accumulates on the wall of this, in the siphon and in the distribution pipes. This should be removed at intervals; by scraping or brushing in the tank; by flushing the pipes, preceded by scraping and brushing by means of rods if necessary. The pipes of the distribution system should be flushed regularly, say once a month, and thoroughly cleaned. Chlorine applied in the dosing tank for 24 hours at the rate of 10 ppm will usually remove grease from pipes and nozzles and filter stone; probably double the amount for 12 hours would serve the same purpose.

If the primary effluent reaching the filter contains any suspended matter (and most do), passing it through a screen of not greater than ¼" mesh before it reaches the dosing tank is desirable. Even then, small floating matters, hairs, etc., and clots of fungus growths from the pipes, are likely to reach the nozzles and clog them wholly or partly. This is especially true of stationary nozzles; those on rotary distributors are generally larger. The bed should be inspected carefully at least once a day and the nozzles that are not spraying perfectly noted, and these should be cleaned during a subsequent rest period. For locating stationary nozzles, a simple way is to assign letters—A, B, C, etc.—to the branch distributing pipes, and, standing in line with each branch in succession, count the number of nozzles from the nearest end to the nozzle to be located. In some plants as many as 5% to 10% of the nozzles become partially clogged each day, but this should be remedied by keeping the distribution system clean and fine-screening the sewage.

In the case of rotary distributors, the nozzles and arms should be kept clean. Also the mechanism should be lubricated in accordance with the directions of the manufacturer.

Ponding or pooling may be due to delay in unloading but more commonly is caused by surface deposits of sewage solids due to non-uniform distribution by nozzles, improper gradation of filter stones or spalling if same, dirt and leaves blown on to the filter, etc. The immediate remedy is to wash the surface with a fire hose; or, if this is not effective, loosen the top stones for a foot or so down with a pick, fork or rake and wash them thoroughly with a fire hose. If the stones are of non-uniform or improper size they should be replaced. Another method is to apply chlorine

TRANSLOT



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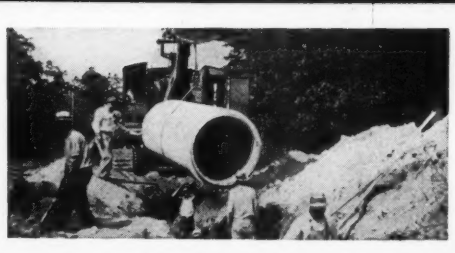

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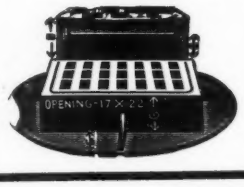

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to the liquid before it reaches the filter so that there will be 0.5 to 1.0 ppm at the nozzles; repeating this at intervals of a day or two for 8-hour periods. This may require applying 3 to 5 ppm; less if done at night when the chlorine demand of the sewage itself is usually least. Too heavy doses should be avoided as they may remove all the gelatinous growth from the stones. If only small areas are ponding, the chlorine may be applied directly to such areas.

It is sometimes possible to make a filter unload by allowing it to dry out for 12 to 48 hours; or to flood it for 12 to 18 hours; the growth on the stone may dry loose in the former method or soften in the latter, so as to wash out through the drains. If ponding keeps recurring on certain areas and the distribution of the sewage is not at fault, it may be due to stoppage of a drain, and this should be located and removed. If the drain is not the cause, it is probably a stoppage in the stone, and this should be removed down to the drains and replaced.

In cold weather, precautions should be taken against freezing. Where there are long intervals between flushes it may be desirable to open a valve slightly on the end of each distributor branch or arm so that these will drain out at the end of each flush.

Two features give some operators more trouble than anything else—filter flies and odors. The flies lay eggs in the film on the filter stones near the surface, (it is thought that the continuous spraying and frequent unloading of high-rate filters will prevent this) and the larvae and pupae live there and develop into flies. If, during this period, the bed be flooded to the top, they will be drowned. Or gasoline can be sprayed over the bed and burned. The use of chlorine, as for ponding, also has been tried. Other methods not so generally successful are use of kerosene, alone or with orthodichlorobenzene or pyrethrum; or pyrethrum alone; or creosote or ammonia.

Strong odors around a sewage plant often come from exposure of sewage solids and grease, and all surfaces should be kept clean of these. The side walls of the filter are apt to receive such deposits in the spray thrown or blown against them, and should be kept clean. Peculiar to the sprinkling filter is the escape of odorous gases from the spray. The remedy for this is to prevent the formation of such gases. The most generally successful method is to apply chlorine to the sewage before it reaches the filter — even before it reaches the sedimentation tank. From 10 to 20 ppm of sewage is recommended, although some operators have been successful with as low as 6 or even 4 ppm. The fresher the sewage the less the chlorine required for eliminating hydrogen sulphide.

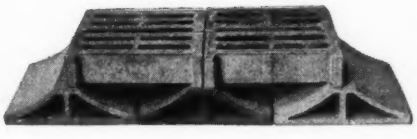
Construction Costs:

Costs and other data for 100 sprinkling filters throughout the country, collected by the Ohio Conference on Sewage Treatment, gave cost per acre from $10,700 to $178,000, average $65,000 per acre; average cost per capita, $5.50 to $6.00; or about $35,000 per million gallons per day capacity. Others have estimated the average costs (presumably for California plants) at as high as double these figures.

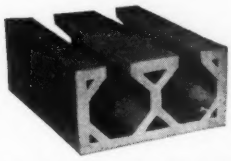
The only safe way is to prepare an estimate for the plant in question, taking local conditions into consideration. The chief items may be classified as excavation and grading; enclosing wall and bottom (usually concrete); tile drainage system (estimate from manufacturer); stone and placing same (probably the largest item); distributing and dosing equipment (estimate from manufacturer). If stationary nozzles are used, the distributing piping can be designed and cost estimated, although the nozzle manufacturer will probably give estimate for the entire distributing system if asked.

"METRO"

VITRIFIED FLOOR SYSTEMS FOR TRICKLING FILTERS



Both ("Metro") Trickling Filter Floors are so designed that dust and small stone can be removed readily from the channels when the filter media is being placed.



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The "Metro" Two-Piece Vitrified Floor System for Trickling Filters, has been tested and has proven itself to be superior to anything of its type, both as to results obtained and simplicity of construction. The percentage of open area in the floor is the largest obtainable within safe limits of the load carried.

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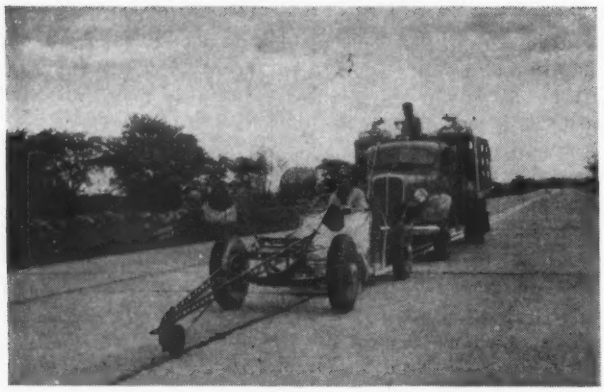


Front view of striping machine at work.

High Speed Highway Lane

This machine of almost human intelligence puts down solid or broken lines, 2-color if desired, 1 or more lines, 20 to 40 miles per day.

FOR the past several years the Buffalo District of the New York State Department of Public Works has been experimenting with devices to increase the amount of markings which could be placed on pavements in one day. It has been only within the past year that a nozzle has been obtained which, together with other coordinating equipment, would provide for the placing of a good paint line on the pavement when operating the machine at a speed of 10 to 12 miles per hour. The machine and devices which will accomplish this are described in this article. It should not be thought, however, that this is a final arrangement, or "last word" device, as the entire equipment is still in the experimental stage. Further experiments or attempted improvements may or may not prove to be advantageous. No doubt mechinics who work with the basic machine will suggest alterations from time to time. It is believed, however, that the equipment which was used in the 1939 season, and which on some occasions painted in excess of 40 miles a day, is a reasonably satisfactory machine, and that similar equipment can be built by others with confidence that expected results will be obtained.

General Description of Painting Outfit

The painting unit consists of three spray paint guns supported on an axle with two wheels and arranged so that one or two lines may be painted at the same time. Any one of these lines may be a full line or a broken line. The New York State standard for a broken line is a paint line 15 feet long, with a space of 25 feet. The device for placing the broken line automatically is described later in this article. The machine is designed to use only one color of paint. Our standard provides for white paint. It would not be difficult to alter this machine so as to place two colors at the same time.

The painting unit is incorporated in a four-wheel narrow gauge chassis, which is called a pushmobile. The vehicle is propelled by a 2½-ton truck, which carries two 60-gallon pressure tanks equipped with agitators, a power-operated compressor of sufficient capacity to provide pressure for one of the paint tanks and at the same time to provide air for the agitator motor on the other tank, a 50-gallon drum with hand agitator for mixing a reserve supply of paint, and flags for the protection of the paint line. In some sections of the State the painting unit is attached to the rear of the truck, and the pushmobile is not used.

Of the two methods, it is believed that the pushmobile is better, especially for repainting broken lines. The operator, being in front, can see what is being done, and thus has a better opportunity to reproduce the lines as originally painted. This is difficult to do from a "blind" position at the rear of a truck.

Center line solid, others broken.

The spray guns used on this machine are of commercial manufacture. The nozzles are of a special design to permit of a greater capacity of paint than the ordinary nozzles on the market.

For two color work a special valve has been devised for installation in the air line. With this secondary valve and with the extra paint nozzles set in tandem, it is possible to shift from one color paint to another simply by turning a set of levers. With this arrangement, parallel lines of different colors may be placed. In New York State white paint only is used.

The machine described will paint at the rate of 10 miles per hour on concrete or other pavements of tight texture, and at a slightly lower rate on pavements of the open type. Experiments with the use of a second nozzle installed in tandem to increase the operating speeds on open textured pavements are now being conducted. It is believed that the practical maximum speed for placing lane marking on a pavement is not more than 35 to 40 miles per day. The limit is affected considerably by weather and other conditions, and by the length of wet paint behind the machine. The average performance should exceed 20 miles per day. The organization for the operation of the unit should be so perfected that the machine is kept moving forward, and the number of stops should be kept at a minimum. Any and all arrangements or devices which tend to avoid the necessity for stopping, increase the mileage covered per day.

Description of Pushmobile

The pushmobile is framed in such a way that the painting unit can be attached just back of the front

Marking With Automatic Device for Dash Lines

By CHARLES R. WATERS

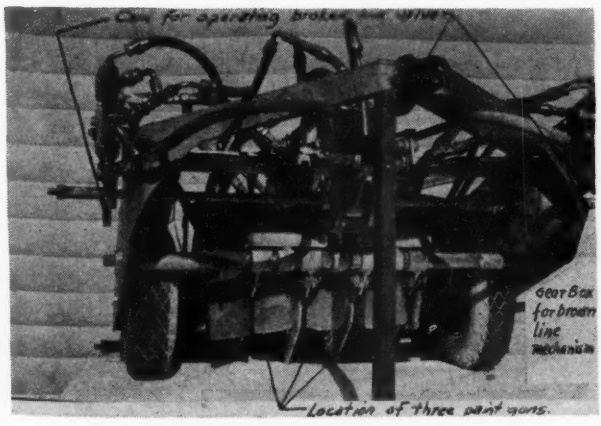
District Engineer, New York State Department of Public Works, Buffalo, N. Y.

wheels and in front of the driver's seat. The method of attachment provides that the unit can be operated from an outrigger or a projecting arm on the side of the pushmobile. In units having two guns instead of three, it is advisable for operating purposes to have a means of shifting the carriage four to six inches to right or left. This is accomplished by a lever arrangement. It is also necessary to raise the painting unit from the ground when traveling from one place to another. This is accomplished by moving a lever which pulls a cable attached to the unit at two points.

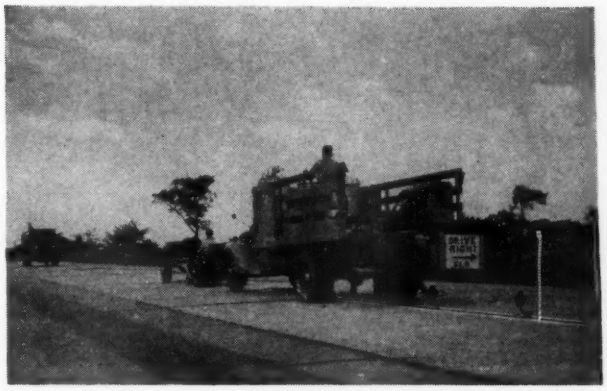
As indicated in the accompanying pictures, accurate steering is accomplished by a long arm which rides the pavement in advance of the front wheels. A relatively large movement of this forward arm is reflected in a small movement of the pushmobile. A special arrangement is made in the front steering device so that the rear wheels of the pushmobile coincide with the front wheels when negotiating curves.

Automatic Equipment for Painting Broken Lines

The principle used in the spraying apparatus is simple. It consists of a valve in the air line which operates the paint nozzle valve. This air valve is opened and closed by a cam operated by a set of gears attached to the axle of the paint application unit. An air valve and cam are provided for each of the three paint guns. The gear box consists of three gears attached with a chain drive to a sprocket on the axle of the paint buggy. The gears and cam for the machine have been designed so that one complete revolution of the cam provides for a length of 40 feet on the pavement. This total cycle of 40 feet provides for the 15-foot paint line and the 25-foot space. The cam is made in two sections so that it is adjustable, and the length



The working parts of the marker.



The machine and crew at work. Five men; 8 to 10 miles an hour.

of the high point of the cam may be enlarged. This provides for changing the length of the paint line or the ratio of the painted line to the non-painted space.

Repainting Broken Lines

It is necessary to re-paint pavement markings at least every year, and some thought was given to the question of whether or not the broken lines could be re-painted exactly. This problem was partially solved by placing inflated rubber tires, instead of the hard rubber tires, on the painting unit. By changing the air pressure in the pneumatic tires, it was found that the original broken lines can be duplicated within a few inches, which is reasonably satisfactory. Experiments are now being made with a variable gear transmission, and it is hoped that with the installation of this device the adjustment of cycle length in re-painting broken lines can be duplicated exactly, and that the length of the painted line can be readily changed by the operator without stopping the equipment.

Operating Crew; Costs

The paint machine and truck carry an operating crew of 5 men—one man steering the pushmobile, one man operating the paint controls, truck driver, one man mixing paint on the truck and watching the air compressor, and one man dropping flags from the rear step of the truck. In addition to this crew, a service truck with driver and one man to pick up flags accompanies the unit. This truck brings the flags ahead to replenish the supply of the paint machine.

The system of pavement markings in New York State provides for the use of a 4-inch width broken line, full line, and double line. The records show that approximately 10 gallons of paint per mile are

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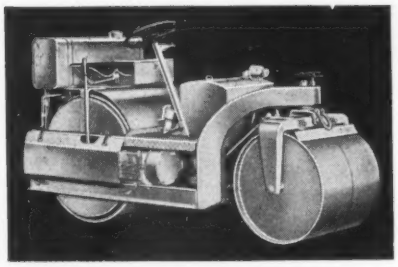

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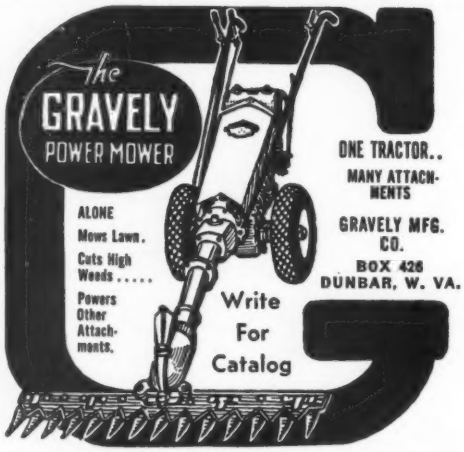

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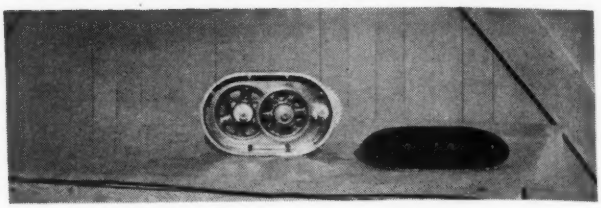


Gear box with cover removed.

required for a solid 4-inch line, 20 gallons for a double 4-inch line, and approximately 4 gallons for a broken 4-inch line, 15 feet on, 25 feet off. Accurate cost data were kept on the work which was performed during the past year on a large mileage of highways. The average for a broken line was $5.90 per mile; single line $13.00 per mile, and double line $24.30 per mile. These costs include truck, labor and materials. The contract price for paint during the past year has been $1.02 per gallon. These cost figures do not include the preliminary engineering and field layout work. The main item in the figures is paint and it can be seen, therefore, that the use of the dash line provides a considerable saving in cost. The paint used is reasonably durable, and except in unusual circumstances, will last throughout one year.

The accompanying pictures give general views of the equipment and details of the painting unit. The development and experimental work in connection with the manufacture of this apparatus has been performed by Chief District Mechanic Claude Naber, and an assistant mechanic, I. H. Beaman, under the general supervision of the writer. Arthur W. Brandt is Superintendent of Public Works, and Harvey O. Schermerhorn is Commissioner of Highways.

79% of County Roads Are Built by Force Account

(Continued from page 11)

Thus plant-mix appears to be one type of surface where contract construction predominates, though by a narrow margin. Though 52½% of the counties prefer force account methods, 52.1% of the mileage was built by contract. With counties employing contract work, the average built per county was 11.1 miles, as against 9.3 miles for those reporting force account work. In 12 states there were counties in which force account work was carried on; contract work by some counties in 10 states, 5 states employing both methods.

Other Types of Surfaces:

Under "other types of surfaces" were reported 117 miles of portland cement concrete built by 10 counties; 156 miles of bituminous macadam and 721 miles of other or unclassified types of macadam by 43 counties; sheet asphalt or bituminous concrete, 96 miles. Stabilized base, calcium chloride stabilization; salt stabilization and bituminous stabilizaton also were reported by several counties.

Comments by County Officials

ALABAMA—Tallapoosa County, Ala., according to J. Percy Oliver, Judge of Probate, participated with the state in blacktopping 92 miles of road in the last 18 months. This county has just ordered two 6-yard Le Tourneaus, 2 patrols and one stone crusher; it now operates 10 tractors and graders.

CALIFORNIA—Julius B. Manthey, County Surveyor, San Joaquin County, Calif., reports that his most interesting job last year was the design of an electrically

operated swing type drawbridge; and his most important future job is the replacement of 10 vehicle ferries with drawbridges.

The control of damage due to flash floods in Caliente Canyon, says A. D. Munden, Supervisor of District 2, Kern County, Calif., has furnished a real problem. It is being controlled along 11 miles of road principally by relocation and straightening. This district built 75 miles of oil resurfacing last year with its own forces and now has about 650 miles of this type of surface in a total of 1,100 miles of all kinds.

GEORGIA—Georgia engineers seem to have a variety of problems. E. M. Wayne, Jr., County Engineer, Walton County, says his biggest job, and the biggest problem in his county, is sewage disposal. In Ware County, A. J. Strickland has found that the high cost of wood bridge cross-drain maintenance has been cut by installing corrugated culverts. The planning of the work so as to get maximum benefits from a large WPA force has been a problem for V. E. Durden, Chairman, Board of Comrs., Emanuel County.

ILLINOIS—The most difficult problem for O. W. Goerlich, Highway Superintendent, Knox County, Ill., was the removal of two bents of piling and the insertion of a 69-ft. truss into an existing bridge. A difficult job for the near future is to raise a 3-span, 84-ft. bridge 3 ft. 6 in. vertically and extend it at the new elevation with 2 additional 50-ft. spans.

In Carroll County, Ill., S. C. Campbell, County Superintendent, reports that the prevention of erosion in loess soil has been difficult. A problem remaining to be solved is the correction of subsoil conditions to reduce or eliminate frost boils. S. A. Connor, County Superintendent, Jasper County, Ill., comments on the difficulties of operating equipment with a minimum loss of time on accout of WPA restrictions and weather conditions.

"With WPA help," says J. V. Waddell, County Superintendent, Fayette County, Ill., "we have built 238 miles of bank-run gravel roads. We have a new oil field in our county and it has damaged our roads seriously. By 1942 we will have a good income from taxes on the new oil field. We use salt as a stabilizer and have very good results." A number of other engineers speak feelingly regarding oil field development and road construction.

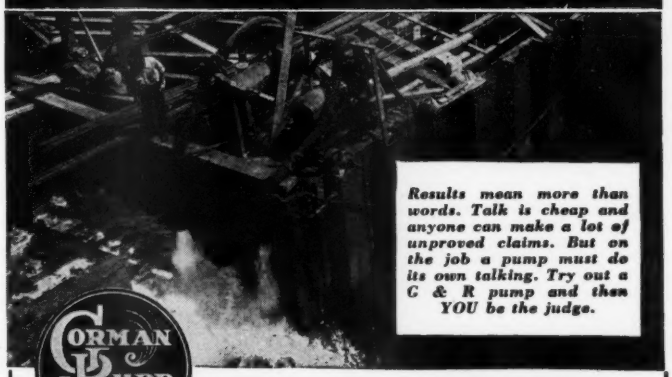
INDIANA—An Indiana highway supervisor says: "My troubles are WPA projects, high waters, ice jams, dust in small unincorporated villages, and drainage." Enough for anyone, we say.

IOWA—From Iowa come a whole flock of interesting comments, as follows: C. Arthur Elliott, Greene County Engineer, "Selling the public on the need for right-of-way above 66-ft. for reconstruction of trunk road system;" Robert Johnson, Marion County Engineer, working out with commission a 3-year financial plan; Roscoe Brady, Decatur County Engineer, finding things that the WPA will approve but that doesn't take all the road money; J. F. Arthurs, Marshall County Engineer, "to get every farm house on a surfaced road"; F. P. G. Halbfass, Muscatine County Engineer, "putting over the biggest construction year we ever had, now successfully concluded"; A. L. Thornton, Pocahontas County Engineer, "replacement of forgotten bridges with modern structures is our biggest job."

A number of engineers in Iowa, Kansas and other states comment on their problems in maintaining gravel roads under the extreme dry weather conditions, and we invite contributions on this subject, as we plan a mild sort of symposium regarding it.

KANSAS—Basil A. Owen, Gray County Engineer, Kansas, is planning to elevate his roads to eliminate trouble with "blow sand" and blow dirt, as well as snow. J. M. Loth, Crawford County Engineer, has been building soil stabilized roads with emulsified asphalt on a WPA project using a concrete mixer. (We have asked Mr. Loth for an article on this and hope he responds.) James F. Meisner, Marion Co., Engineer, who, if we recall correctly, wrote us an interesting article some two years ago on

THE OTHER PUMPS QUIT



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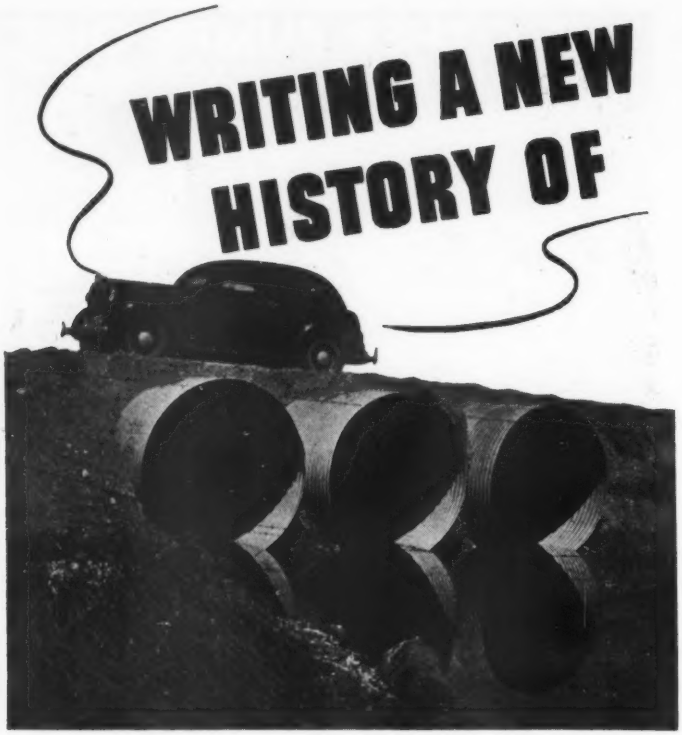

Highway Drainage

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grouting a leaky dam, has been constructing a 300-acre county park, and during the year also built 68 miles of roads. R. E. McDowell, Phillips Co. Engineer, has been building road ponds and intends to build more. (What are road ponds, Mr. McDowell?) Several others report blow dirt problems; and an allied problem of maintenance through a sand hill area. O. C. Carlson, Sedgwick County Engineer, reports two interesting jobs—designing an earth dam for a county lake, and constructing a cement-soil stabilized road.

MICHIGAN—A new reinforced concrete and steel bridge of two 60-ft. spans, with a 26-ft. roadway is reported by R. S. Scott, Alpena County Engineer, Mich.

MINNESOTA—Warren G. Keith, Chisago County Engineer, Minn., reports 80 miles of surveys, plans for 30 miles of road and 30 miles constructed last year with WPA. H. L. Sandin, Otter Tail County Engineer, sends us a beautiful map of his county and reports 137 miles of gravel surface treatment and mixed-in-place last year. P. E. Highum, who says his biggest job last year was coordinating construction operation on a program really too large for Dodge County equipment and budget, lists his most important future job that of bringing bridges up to a par with the road grading. Richard Cook, Redwood County Engineer, is another of the many who remarks on the difficulty of maintaining gravel roads during dry weather and says there is no answer but more moisture. He has been very busy on a bridge replacement and modernization program, both WPA and contract.

MISSISSIPPI—Arthur L. Goodman, Oktibbeha County Engineer, Miss., reports 40 miles of farm-to-market gravel roads constructed.

MISSOURI—Lawrence Best, Daviess County Engineer, Mo., asks for information on river bank protection and control of steam alinement; something low in cost. (Mr. Williams' article in our April issue may help him.)

NEBRASKA—An interesting job last year in Jefferson County, Neb., reported by F. D. Harlan, County Engineer, was the building of 10 all welded deck girder bridges. L. W. Weaver, Lancaster County Engineer, Neb., built a half a mile of 42-ft. concrete by contract using WPA labor.

NEW JERSEY—Harry F. Harris, County Engineer, Mercer County, N. J., reports the construction of footwalks along county roads in areas near schools, industries and recreation centers. He is planning the replacement or modernization of 400 county bridges and culverts, including 20 or more steel bridges over 50 years old and some culverts over 100 years old.

NEW YORK—Bertram E. Murray, Warren County, N. Y., Highway Superintendent, last year built a bridge over the Schroon River of one 40-ft. I-beam span, one 100-ft. plate girder span and one 45-ft. I-beam span.

NORTH DAKOTA—J. G. Lund, Traill County Engineer, N. D., reports building a new concrete garage, 50x120 ft., with WPA.

OHIO—In Ohio, L. H. Schmenk, Putnam County Engineer, reports building cold patch plant at the county garage. This has a maximum capacity of 100 tons a day; about 6,000 tons were laid in 1939 at a saving estimated at $15,000. B. G. Kesting, Lucas County Engineer, Ohio, has installed permanent black center lines in concrete pavements, and is planning to build 10 miles of concrete pavement by WPA.

OKLAHOMA—H. C. Williams, Texas County Engineer, Okla., has had a problem in the bank protection in sandy areas that have lost vegetation during the drouth.

OREGON—Edw. J. Himes, Polk County Engineer, Ore., asks for information on a simple but adequate cost record. H. W. Herring, Yamhill County Surveyor, Ore., is working up a complete road map and preparing to replace old bridges that are insufficient. In Douglas County, Ore., F. C. Frear, County Engineer, says that constant inspection is needed on the 597 bridges in the county so that they can carry safely the heavy logging trucks. Some new bridges are planned.

PENNSYLVANIA—In Pennsylvania, according to Wm.

H. Supplee, Erie County Engineer, the engineer's work is to act as technical adviser to the county commissioners and the supervisors of the townships and boroughs. And according to M. C. Throne, Delaware County Engineer, his department, in addition to the work mentioned by Mr. Supplee, builds all bridges and obtains right-of-way for state roads.

WASHINGTON—Flood control of the rivers in his county has been a problem to W. A. Bugge, Jefferson County Road Engineer, Wash.

WISCONSIN—A. E. Tuttle, Sauk County Highway Comr., Wis., has built 5 miles of "frost-boil proof" road. He built 34 miles of mixed-in-place with his own forces last year and has 235 miles yet to go. Richard A. Smith, Dane County Highway Engineer, makes a brief report of his work. With WPA help, Dane County crushed 116,000 cu. yds. of gravel which cost, in stockpiles, $45,930.34; now operating 3 plants and expects to complete 1940 requirements of 106,000 yards by June 15th.

The above are but a few of the many interesting comments made by those who cooperated in this survey; lack of space prevents quoting more of them.

Much information on WPA was provided; in some places WPA appears to be a headache; in others an appreciated help; in nearly all a financial problem. There is small doubt but that it has aided road construction and even less doubt that the counties are directing it toward greater and greater real utility.

Personal problems are interesting. One annoyed engineer writes that his biggest problem are the elective commissioners who think their election makes them road experts and civil engineers. The biggest problem facing one honest soul was "my reelection." Hundreds of others write interesting, personal and always friendly and cooperative messages. It has been a pleasure to read each one of these 790 questionnaires.

Non-Rattling Wooden Bridge Floors

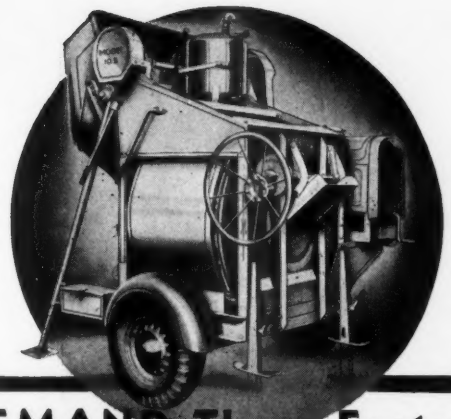
Davidson County, Tennessee, has many steel trusses built 15 to 30 years ago which are strong enough themselves for present-day concentrated loads, but their old wooden floors are not. Moreover, the trusses would not be strong enough to carry the increased dead load caused by concrete floors.

Under these conditions, the county developed a wood floor that had sufficient strength, that did not rattle, and which has been in use for 7 years with no cost for maintenance. This construction consists of using 3" oak floor plank laid crosswise of the bridge and sprung so as to give a slightly arched cross-section. This is effected by using different depths of steel stringers so that the center ones are higher than those supporting the ends of the planks.

The flanges of the outer stringers are bored at uniform intervals, the floor planks are bored to match; and a curb timber on top of each end of the planks is similarly bored, so that a bolt can be run through each set of holes which, when the nut is drawn up, pulls the planks down onto the outer stringers. Spacers are placed between curb timbers and floor planks, cut at intervals to provide scuppers. The floor planks are surfaced on the under side and both edges, one edge being slightly beveled so that, when adjacent planks are snug at the bottom there is an opening of 1/8 in. at the top.

The floor is then treated with hot asphalt and crushed stone, which seals it from the weather and tends to keep the plank pliable. The smooth under surface is treated with creosote before laying.

The above is abstracted from an article in the "Tennessee Road Builder," by J. C. Akers, Engineer, Davidson Co. Highway Dept.



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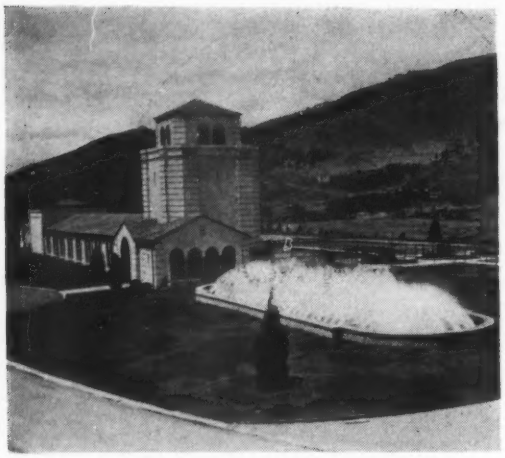

Upper San Leandro filter plant, Oakland, Calif.

The Waterworks Digest

Abstracts of the main features of all important articles dealing with waterworks and water purification that appeared in the previous month's periodicals.

HOW TO FIND ORIGINAL ARTICLES. Key letter at end of each digest refers to name of publication listed in bibliography at end of this section. Numeral indicates title of article.

Toledo's New Filter Plant

Toledo, O., is building a filter plant of 80 mgd. capacity, 45 min. reaction period, 3 hr. sedimentation period, 2 gal. per sq. ft. per min. filtration rate. Paddle wheel flocculators in each of four reaction chambers. Carbonation chambers with retention period of 12 min. Filters have back wash capacities up to 25 gal. per sq. ft. per min. and surface wash up to 10 gal. Wheeler filter bottoms are used. Surface wash will be through removable caps on vertical pipes, each cap drilled with 5 holes, one giving a vertical jet, the others making an angle of 38° with the horizontal.[F30]

Cation and Anion Exchangers

During the past 2 years two new groups of filtering materials have appeared on the market. Cation exchangers are carbonaceous zeolites for removing calcium, magnesium, sodium and other positive ions, acting like ordinary zeolites; regenerated with mineral acids. Anion exchangers are able to remove carbonates, bicarbonates, sulfates, chlorides and nitrates and other negative ions; regenerated with sodium hydroxide. It is now possible to remove salt (sodium chloride) from water. The former are sold under the names Catex, Zeo-karb, Nalcite A and Organolite; the latter under the names Nalcite B, Anex and De-acidite. A plant for using cation exchangers might cost $50,000 per million gallons capacity and $25 for operating cost; and $60,000 for plant and $20 for operation using anion exchangers. The cation exchangers are especially suited for softening waters of high alkalinity and for recarbonating lime softened water. There is no sludge to dispose of. They neither remove nor increase the silica content. Anion exchangers are especially suitable for removing alkali salts in brackish water. Water for treatment by both cation and anion exchangers must have turbidities not over 5 to 10 ppm. The high cost confines their use to special conditions.[A67]

Chicago's Filter Plant

Chicago has under construction the largest rapid sand filtration plant designed or built up to the present time, estimated to cost over $20,000,000. The capacity of 450 mgd is based on a maximum average daily filtration rate of 2.5 gpm per sq. ft. in winter and 3 gpm in summer, acid-treated sodium silicate being used to strengthen the coagulation during periods when the floc produced by a simple coagulant would not be strong. For periods of several hours daily the rates may be increased to 3 gpm in winter and 4 in summer. Should a coagulant only be used, the maximum winter rate should not average more than 2 gpm for any one day nor exceed 2.5 at any time. There will be 45 min. mixing time for the average of the maximum summer rate of 360 mgd and about 35 min. for the peak hour demand of 460 mgd; the settling time will be 4 hr. for the yearly average treated, reduced to 2½ hr. at the peak rate.

The plant will be equipped for storing and feeding into the water aluminum sulfate, ferrous sulfate, ferric sulfate, lime, sodium silicate, sulfuric acid, powdered activated carbon, ammonia or ammonium sulfate, and chlorine.[F42]

An Aerated Mixing Tank

In the new filter plant at Rockport, Mass., an aerated mixing tank provides for both the mixing of chemicals with the raw water and aeration for odor removal. The tank is 4 ft. by 11 ft. by 11.75 water depth, giving a detention period at rated capacity (1 mgd) of 5.6 min. A small air compressor feeds air through 8 carborundum diffuser plates set in a plate holder 1.5 ft. wide by 9.5 ft. long in the bottom of the tank, at the rate of about 24 cu. ft. per minute. The chemicals are discharged through feeder hoses at the surface of the water.[F44]

Ozonizing Denver's Water Supply

The supply of Denver, Pa., 2100 population, is drawn from a creek and filtered through two 150,000 gpd gravity filters. Ozone was adopted to remove tastes and odors as well as sterilize the water; this being the first plant of this type to be put into operation. The ozone installation, with a capacity of 5 lbs. per day, includes equipment for drying and cooling the air, the ozone generator, and diffusion and mixing apparatus. Compression, cooling and expansion remove 80% of the moisture in the air and chemical driers the remaining 20%. For ozone generation, the current is stepped up to 25,000 volts. The air, carrying about 0.5% pure ozone, is introduced into the clear well through porous diffuser tubes and mixed with the water by an absorption wheel. The plant was put into operation in March 1940 and no operating data are yet available.[E14]

Ozone Treatment at Ashton, England

Ozone treatment of water has had its greatest developments in France, where there are 90 installations on public water supplies; Italy has 14; England, 4; other countries 11. It has recently been installed at Ashton, England, with a capacity of 60,000 gph. Here air is blown through a desiccator using calcium chloride and coke; then between glass dielectrics, the silent flame high tension discharge

-now the time is almost here

Yes sir, swimmin' time will be along any day now. And as the days get warmer and warmer, there comes a time when a feller's jest naturally got to take his clothes off and go in swimmin'.

You know the feeling. It's as inevitable as the trees turning green. But to some of the older fellows, much as they don't like the idea, this is the time when paint cans come out, and bright new signs are nailed up that say: "NO SWIMMING HERE —POLLUTED WATER!"

Naturally, the 'Board' is not out to spoil anybody's enjoyment, and if the use of "no swimming" signs could possibly be avoided . . .

MR. COMMISSIONER! HERE'S THE ANSWER! You don't need those signs. Just make sure that all effluent from your sewage disposal and waste plants is doubly purified with Solvay Liquid Chlorine! . . . and everybody will stay well and happy. Write for complete information today.

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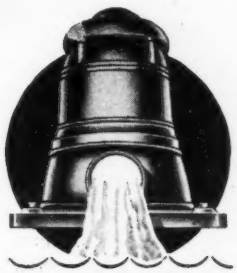

Forty-eight miles south of Memphis, for the Illinois Central System, a Layne Well Water System is pumping 45,000 gallons of water daily for the equivalent cost of three packs of cigarettes. Three years of continuous operation has brought no shut down for repairs; no expense of upkeep. This is typical of low cost operation and efficiency of Layne Well Water Systems.

Other Layne installations are providing up to 20,000,000 gallons of water daily at an even lower gallonage cost. Such performance is evident proof that years of experience and highest skill have combined to produce wells and pumps of outstanding quality and efficiency.

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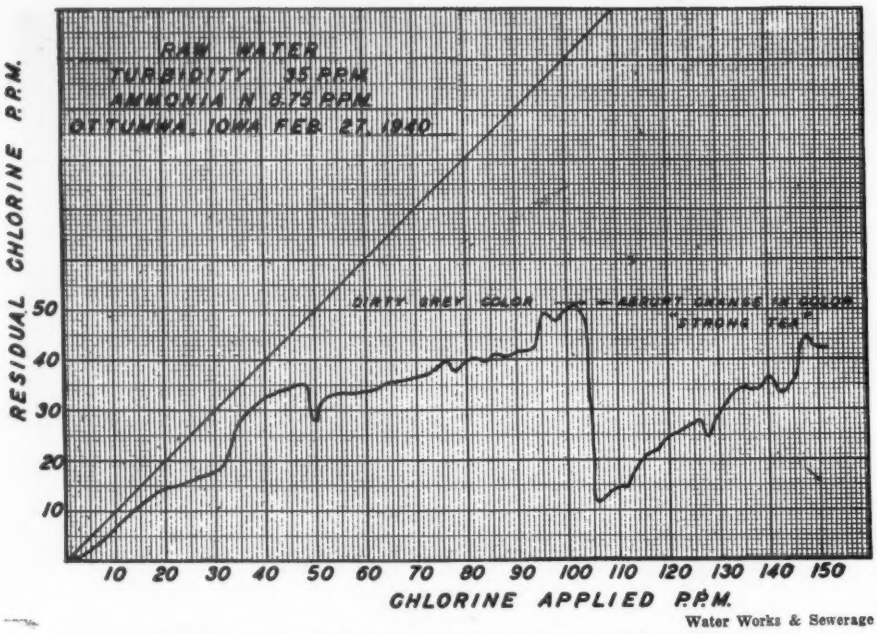
RAW WATER
TURBIDITY 35 PPM
AMMONIA N 0.75 PPM
AT TUMWA, IOWA FEB. 27, 1940
RESIDUAL CHLORINE P.P.M.
DIRTY GREY COLOR
SLIGHT CHANGE IN COLOR
STRONG TEA
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
CHLORINE APPLIED P.P.M.

Water Works & Sewerage

"Break point" at 106 ppm, residual dropping from 51 to 11.5 ppm.

between which converts part of the air to ozone. This is mixed with water, which then passes down a contact column. Current is used at 20,000 volts, 500 cycles. The cost there is 1£ 2s. 5d. per million gallons (British). If a 45 ft. head is available for the contact column without pumping, deduct 8s.

The process is especially applicable to clear water, free of algae. Prior treatment through filters or even screens may be desirable. It is especially effective in removing peat stain and other colors not readily removed otherwise.[D5]

Chlorine at More Than 100 ppm

Last winter the water in the Des Moines river, used by Ottumwa as a source of supply, was more than 50% sewage from Des Moines. After the river froze over Dec. 26 the dissolved oxygen disappeared, the 107 miles of river from Des Moines to Ottumwa became practically a septic tank, truck loads of dead fish were removed from the water works intake daily, the B.O.D. reached 60 or 70, and the threshold odor about 600. The water was undrinkable, and prechlorination was tried as a remedy. Trial of 1 ppm, then 3, gave little result. A new, larger W. & T. chlorinator was obtained and 13.6 ppm. fed, the filtered water being dechlorinated with sodium bisulphite fed by a "Proportioneers" pump. The threshold odor was still 40 to 50. Then jar tests were made to learn the chlorine "breaking point," which was not reached until 112 ppm had been added. With this the residual was only 9.1 ppm, while with a dose of 110 it had been 41.4. Next day the plant dose began with 96 ppm and the breaking point was found at 106, the residual being 11.5, whereas the residual at 104 was 47.7. Doses were continued to 152 ppm but no secondary break appeared. The threshold odor of the treated water was not over 2. Special apparatus had to be designed to handle such doses—almost 8,000 lb. of chlorine per day. It was necessary to use 12 1-ton containers at a time to prevent their freezing by too rapid discharge. By March 18 the river was rapidly opening up and the chlorine dose was reduced and in a few days was back to normal.[G14]

Alkali Treatment for Corrosion Prevention

The most common method of water treatment for the purpose of decreasing the corrosive action of water is the addition of alkalis, generally lime but often soda ash or caustic soda. Unfortunately, observations on the effect of this treatment have demonstrated that it will not entirely control corrosion. The coatings which form are not pure calcium carbonate, but compounds or mixtures of several substances; they are usually soft, mushy, and pervious to water. It has been shown that tuberculation can take place in a water treated to secure chemical balance and that tubercles will form in spite of the protective coating. It looks very much as though the principal value of this coating is to provide an alkaline zone at the metal surface so that corrosion may be retarded and the products of corrosion may be precipitated as they are formed. This would tend to explain the fact that alkali treatment seems to correct red water conditions because, instead of the iron being dissolved and carried away, it would be deposited largely in situ. In spite of its limitations, alkali treatment remains the cheapest and simplest method of water treatment readily available at present.

Sodium silicate has been used for corrosion prevention with success in some cases. Use of sodium hexametaphosphate looks promising. But at present no method of treatment has been perfected which will give universal protection against tuberculation.[A62]

Corrosion of Plumbing

Corrosion of consumers' plumbing has been caused by (1) stray current electrolysis (rare); (2) corrosive water and tuberculation; (3) poor galvanizing; (4) dezincification of brass pipe; (5) use of dissimilar metals (galvanic action and thermocouple effects); (6) use of water softeners (electrolytic concentration cells); (7) high-pressure high-velocity flows of water that dislodge protective scale of corrosion products, thus exposing underlying metal to further corrosive attacks; (8) leakage of refrigerant at joints and connections (acid attack on metal). In connection with (5), "the use of brass tubes for inlets or outlets to hot water tanks is positively inexcusable". "Wherever a juncture between dissimilar metals cannot be avoided (a multiplicity of them should never be tolerated), an electrolytically insulating protective coating should be applied over the joint, and should be extended well past the juncture point in both directions." As to (7), reduction of excessive pressures and prevention of abrupt changes in velocity of flow will materially reduce the number of failures resulting from this cause.[A63]

Bibliography of Waterworks Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

A *Journal, American Water Works Ass'n. March*

58. Publicizing a Good Rate Structure. By W. A. Peters. Pp. 365-370.
59. Economic Evaluation of Tuberculation in Pipe Lines. By L. J. Alexander. Pp. 371-386.
60. Corrosion and Tuberculation. By H. A. Knudsen. Pp. 387-393.
61. Corrosion Control. By O. C. Blumberg. Pp. 394-400.
62. Outline of the Corrosion Problem in Water Works. By G. D. Norcom. Pp. 401-407.
63. Corrosion of Consumers' Plumbing. By R. R. Ashline. Pp. 408-413.

64. c. Jacking 72" Culvert Pipe Under Outfall Sewer. By R. Shepherd. Pp. 414-422.
65. Maintenance of Pumps, Motors and Controls. By J. Brower. Pp. 423-430.
66. t. Enlarging a Main at Point of Diversion of a Branch. By S. A. Evans. Pp. 431-434.
67. Removal of Salts from Water. By R. F. Goudey. Pp. 435-455.
68. Sanitary Standards for Hotels. By G. E. Arnold. Pp. 456-464.
69. Water Pollution by Petroleum Oils. By M. M. Gibbons. Pp. 465-477.
70. t. Calculating Most Probable Numbers in Coli-Aerogenes Analyses. By R. Pomeroy. Pp. 478-486.
71. Determination of Small Amounts of Cyanide in Water. By J. E. Fasken. Pp. 487-493.
72. Porous Filter Bottoms at Flat Rock, Mich. By L. Stevens. Pp. 494-501.

D *The Surveyor*
March 1

2. Frozen Water Mains and Service Pipes. By A. Boothman. Pp. 207-208.
3. p. Valuation of Water Undertakings for Rating Purposes. By W. R. Ward. Pp. 213-214.

March 15

4. Science and the Divining Rod. By J. C. Maby. Pp. 253-254.

March 22

5. p. The Treatment of Water by Ozone. By M. T. B. Whitson. Pp. 279-280.
6. London's Water Supplies, Annual Report. Pp. 281-282.

April 5

7. Water Waste Prevention Methods. By A. M. Moon. Pp. 311-313.

E *Engineering News-Record*
March 28

10. Motors and Controls for Pumps and Compressors. By G. H. Hall. Pp. 50-52.
11. Great Lakes Water for Grand Rapids. Pp. 56-59.
12. p. Drafting in the Water Works Office. P. 59.

April 11

13. New York's Delaware River Project. By C. M. Clark. Pp. 83-85.
14. Ozone for Taste and Odor Control at Denver, Pa. By F. H. Dechant. Pp. 86-87.
15. Pinning a Pipe Line on Pikes Peak. By E. L. Mosley. Pp. 88-90.
16. Break-Point Chlorination for Taste Control. By W. J. Orchard. Pp. 91-92.
17. Reservoir Fish Not Poisoned by Copper Sulphate or Rotenone. P. 92.
18. Damping Surge in Toledo's New Conduits. By P. Hansen and P. E. Langdon. Pp. 93-94.
19. Algae Growth Affected by Ultra-Violet Rays, Not by Temperature. By R. F. Goudey. Pp. 95-97.
20. Double-Deck Settling Basins at Chicago. By L. D. Gayton. Pp. 98-100.

F *Water Works Engineering*
March 27

34. New Pumps Reduce Power Costs at Quincy, Ill. By W. R. Gelston. Pp. 340-342.
35. Water Problem of a Small Village. By H. Keinath and W. C. Hirn. Pp. 349-351.
36. Protecting an Airport Against Fire. By R. H. New. Pp. 359-360, 378.
37. Controlling the Work of Plumbers. Pp. 364-365.

April 10

38. Taste and Odor Treatment. By N. J. Howard. Pp. 420-423.
39. Lime-Zeolite Softening Plant — La Grange, Ill. By L. R. Howson. Pp. 424-426.
40. c. Rapid Tunnel Driving on Delaware Aqueduct. Pp. 427-432.
41. Cross Connection Practices. By J. S. Longwell. Pp. 433-437.
42. World's Largest Filter Plant. By L. D. Gayton. Pp. 438-443.
43. Performance of Water Meters in New York City. By E. Nuebling. Pp. 446-447, 455, 456, 499, 500, 544.
44. Filtered Water for Rockport, Mass. By E. S. Chase. Pp. 459-460, 463.
45. Short Schools for Operators. Pp. 464, 467, 468, 471, 472.
46. A Program for Cleaning a River. By C. W. Klassen. Pp. 475, 476, 488.
47. Electrifying the Pumping Station at Knoxville. By W. S. Baum. Pp. 479, 480.
48. Operation and Maintenance of Hydrants. Pp. 487-488.
49. Coal Tar Enamels for Protective Coatings. By H. Hayes. Pp. 503, 504, 505, 507, 508, 511, 512, 515, 516, 542.

G *Water Works & Sewerage*
April

13. Milwaukee's Water Purification Plant. By J. P. Schwada. Pp. 137-145.
14. Super-Chlorination at Ottumwa, Ia. By H. A. Brown. Pp. 146-151.
15. Metering and Meter Shop Practice. By M. B. Cunningham. Pp. 165-168.
16. Watching Friction Increase in Pipe Lines. By D. R. Taylor. Pp. 169-171.
17. Corrosion Control at Lewiston, Ida. By W. P. Hughes. Pp. 172-175.

J *American City*
April

12. Zeolite Water Softening at East Lansing, Mich. By R. J. Faust. Pp. 62-63.
13. Rehabilitating Old Wells at Camden, N. J. By W. M. Lewis. Pp. 73-74.
14. Water Rates and Service Charges. Pp. 105, 107, 109.

L *Civil Engineering*
April

5. Studies of a Near-Maximum Storm at St. Louis. By W. W. Horner and four students. Pp. 230-233.
6. Probable Maximum Flood Flow from a Small Watershed. By J. K. Bartlett and T. G. Pfiffner. Pp. 233-235.

P *Public Works*
April

18. n. Attractive Building for a Small Water Plant. P. 19.
19. Operation Details for a Small Water Treatment Plant. By J. M. Lloyd. Pp. 20-22.
20. How to Discover Leaks and Locate Water Wastage. Pp. 28-34, 37-40.

T *Technique Sanitaire et Municipale*
January-February

4. La Purification de l' Eau: Tendances Actuelles. By G. Baxter. Pp. 10-15.

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April

1. Water Purification Plants in the Lake Winnebago Area. Pp. 1-11.

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March-April

2. Ground Water: Its Development, Uses and Conservation. Pp. 1-6.

X *Cast Iron Pipe News*
April

25. 8" Cast Iron Pipe Laid Through Ice at Okoboji, Ia. By J. G. Davis. Pp. 16-18, 23.
26. Pensacola Reroutes C. I. Pipe With Little Delay in Service. By O. J. Semmes, Jr. Pp. 19-21.

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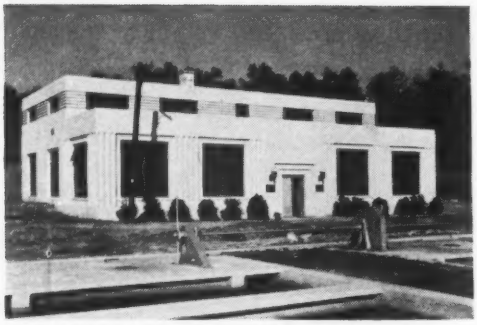

Atlanta, Ga., Sewage Treatment Plant.

The Sewerage Digest

A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published.

HOW TO FIND ORIGINAL ARTICLES. Key letter at end of each digest refers to name of publication listed in bibliography at end of this section. Numeral indicates title of article.

Treating Dairy Wastes

Three years' operation of an activated sludge plant by the H. W. Walker Co., which processes about 54,000 pounds of milk daily, leads to the conclusion that the successful operation of such a plant requires that sufficient milk of lime be used to precipitate and neutralize the suspended caseins and lactic acid to prevent septic action in the primary basin and maintain a pH of 7.6-7.8 in the areation basin. The sludge in the primary settling basin must be recirculated with fresh water to promote settling; which recirculation is stopped for three hours before removing sludge from the basin to the tank truck. Sufficient aeration must be provided to agitate continuously the mixing chamber, and sufficient in the aeration basin to keep the dissolved oxygen above 2 ppm. Sludge from the final settling basin must be recirculated to the aeration basin to seed the effluent from the primary settling basin. The system must be operated continuously to avoid septic action, to insure which, auxiliary blowers must be provided. Periodic B.O.D. and pH determinations should be made to check the efficiency of the plant. At this plant the average B.O.D. reduction was from 545 ppm to 7.4.[C27]

Safety in Disposal Plants

To prevent explosion of combustible gases, explosion-proof electrical equipment is used and spark-proof tools. Other sources of ignition may be static charges, sparks from operators' clothing, sparks from steel striking steel or a cement floor, smoking or not denergizing electric circuits before making repairs.

Combustible gas indicators are now made small enough to go in the pocket. Combustible gas alarms are installed permanently, giving a warning signal if a dangerous concentration of gas occurs; a single one can be used to guard several distant points, such as pipe galleries, meter rooms, near gas engines, etc.

Prevention of accidents from toxic gases, requires detection and protection and resuscitation means. For detecting toxic concentration of hydrogen sulfide, the U. S. Bureau of Mines detector is most used. Other toxic gases and vapors are petroleum, benzol, ammonia, chlorine, etc. Oxygen deficiency is generally determined by a flame detector, the Wolf oxygen deficiency indicator being generally used.

Protection of workmen subjected to such atmospheres is furnished by canister masks if only contaminants (chlorine, hydrogen, sulfide, etc.) are present. For oxygen deficiency, hose masks or self-contained oxygen breathing apparatus should be provided. For work in tanks, etc., miners' cap lamps are desirable; also safety belts. Ordinary unapproved flash lights should not be used in a plant.[C33]

Repairing Dayton's Imhoff Tank

The sewage tanks at Dayton, O., which exploded last year (see PUBLIC WORKS for January, 1939) have been reconstructed and precautions against explosion from sewage gas embodied, both to eliminate all possible sources of explosion and also to prevent damage to the structures should one occur. Weights on the floating gas domes give a gas pressure of 18" of water; if this is exceeded, gas escapes to the atmosphere. All electrical wiring and equipment located in the pipe gallery is of explosion-proof construction; and light and motor switches, junction boxes, light fixtures, and the motor operating the sump pump are of a type approved for hazardous atmospheres.

In the destroyed plant a roof slab covered both conduits and pipe gallery. In the new one a slab covers the conduits only; while the gallery between is roofed over by hollow concrete slabs set with a bituminous filler, containing six ventilating openings, which light slabs would easily be displaced should an explosion occur. A new control house has been built 150 ft. from the tanks, and here, removed from the vicinity of the gas, are located sludge ejectors, motors and control switches.[X21]

"Package Delivery" Treatment Plants

Factory-fabricated plants are being offered, a complete unit being combined in a steel tank ready for operation as soon as installed on its foundation. The units include sedimentation tanks, oxidized sludge aerator-clarifier, chemical coagulation and chlorine sterilization tank, and separate sludge digestion. Transportation limitations fix the maximum diameter of tank at 8 ft., and 25 ft. is the maximum height. Performance data are given of a plant treating milk wastes up to 8,000 gpd.[G12]

Treating Milk Wastes

Milk solids in wastes may approximate 2% of milk solids intake—less in plants producing only canned evaporated milk, more in those producing cheese. Wastes have average 5-day B.O.D. demands of from 750 ppm to 1300 ppm, with daily variations of 60% to 100% above or below the average; causing variations in oxygen loading of 100% of the average. The dissolved organic solids are readily oxidizable with either biological filters or activation. Plain sedimentation readily removes suspended solids with corresponding reduction in oxygen demand.

Milk wastes are treated with good results by plain sedimentation followed by either trickling filters, or pH control with lime and activation, or by the Guggenheim process. The first necessitates the highest capital investment, but the least operating cost (including labor, chemicals, depreciation and capitalization charges) per pound of oxygen demand removed, activated sludge being second.

Trickling filters with applied load controlled as to concentration by dilution, are less subject to injury due to sudden fluctuations in raw waste char-

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acteristics than either of the others. The activated sludge process will give an excellent effluent, but careful attention to operation is required to avoid rapid pH fluctuations or casein accumulations and this process therefore should be used only at large plants. The Guggenheim process also requires careful operation with laboratory control. But no plant will operate entirely automatically, owing to constant and rapid changes in volume, concentration and characteristics. In the case of extremely small plants, intermittent sand filters will give a degree of treatment sufficiently high to meet any requirements with little likelihood of periodic failures due to fluctuations in load concentration and characteristics.[X17]

Control of Activated Sludge

Variables in plant operation include concentration of solids in the mixed liquors, quantity of air used, aeration period, settling period, rate of sludge return, and oxygen consumption. The Chicago North Side plant finds an average of 2300 ppm solids concentration gives best results, which is controlled by the amount of excess sludge wasted.

The amount of air used can be limited to that necessary to obtain good clarification with a minimum of nitrate production. It is desirable to maintain a small amount of D.O. at the head end of the aeraton tank with a gradual increase up to about 2 ppm at the discharge end (some say 1 ppm or even less).

A deep sludge blanket in the final tank tends to become septic. This plant uses a series of small air lifts to determine depth of sludge, the liquid being lifted continuously from 5 different elevations and discharged just above the water surface; readings are taken every 4 hrs. and recorded as sludge, trace or clear. Some tanks have an automatic arrangement for controlling the sludge blanket, operated through a photo-electric cell, to which a small pipe brings the tank liquid, and at intervals the arrangement actuates a motor to partially open or close an air valve on an air lift or a gate valve in the sludge drawoff line.

The first function of activated sludge is removal of colloidal matter by adsorption, after which the floc surfaces must be reactivated by aeration. No satisfactory method has been developed for determining the rate of oxygen absorption of activated sludge-sewage mixtures.

The greatest bane of the operator's life is bulking sludge, which is best expressed by the sludge index. Bulking may be due to filamentous growths (sludge slimy and stringy); to underaeration (sludge light gray in color, little of its flocculent appearance, final tank turbid and milky); or to low ash content—lack of inorganic content (sludge like normal sludge but not so dense).[X18]

Tank Effluent For Fish Pools

Lima, O., in 1938 constructed a fish pool to be filled with effluent from its treatment plant. The pool, shaped like a comma, has a head 11 ft. in diameter and a tail tapering from 6 ft. to 1½ ft., the total length being 26 ft. The large pool is 4 ft. deep at the center, sloping to 2″ at the end. A 2″ drain controlled by a valve leads from the low point. The overflow returns to the outfall sewer, the inflow from which reaches the pool through a ¾″ pipe and trickles into it over stone steps, on each side of which are potted plants. Water lilies in buckets in the pool furnish shade for the fish. Water hyacinths and parrot ferns are planted in the shallows. The pool was covered with hinged sections in cold winter weather. Eleven gold fish in the pond in September survived the winter in a healthy condition and later spawned over 500. Six of these small fish were

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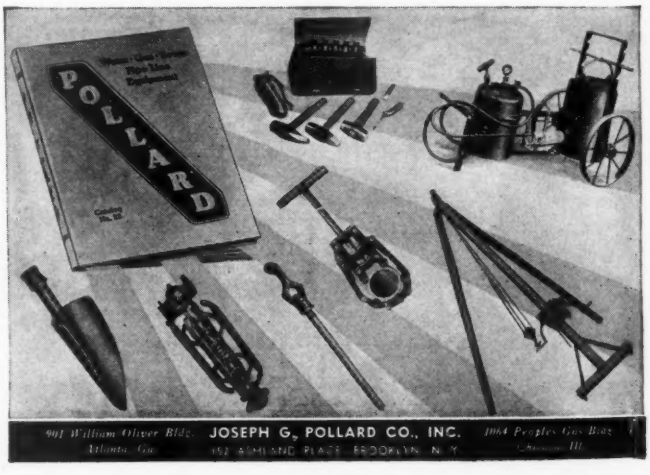

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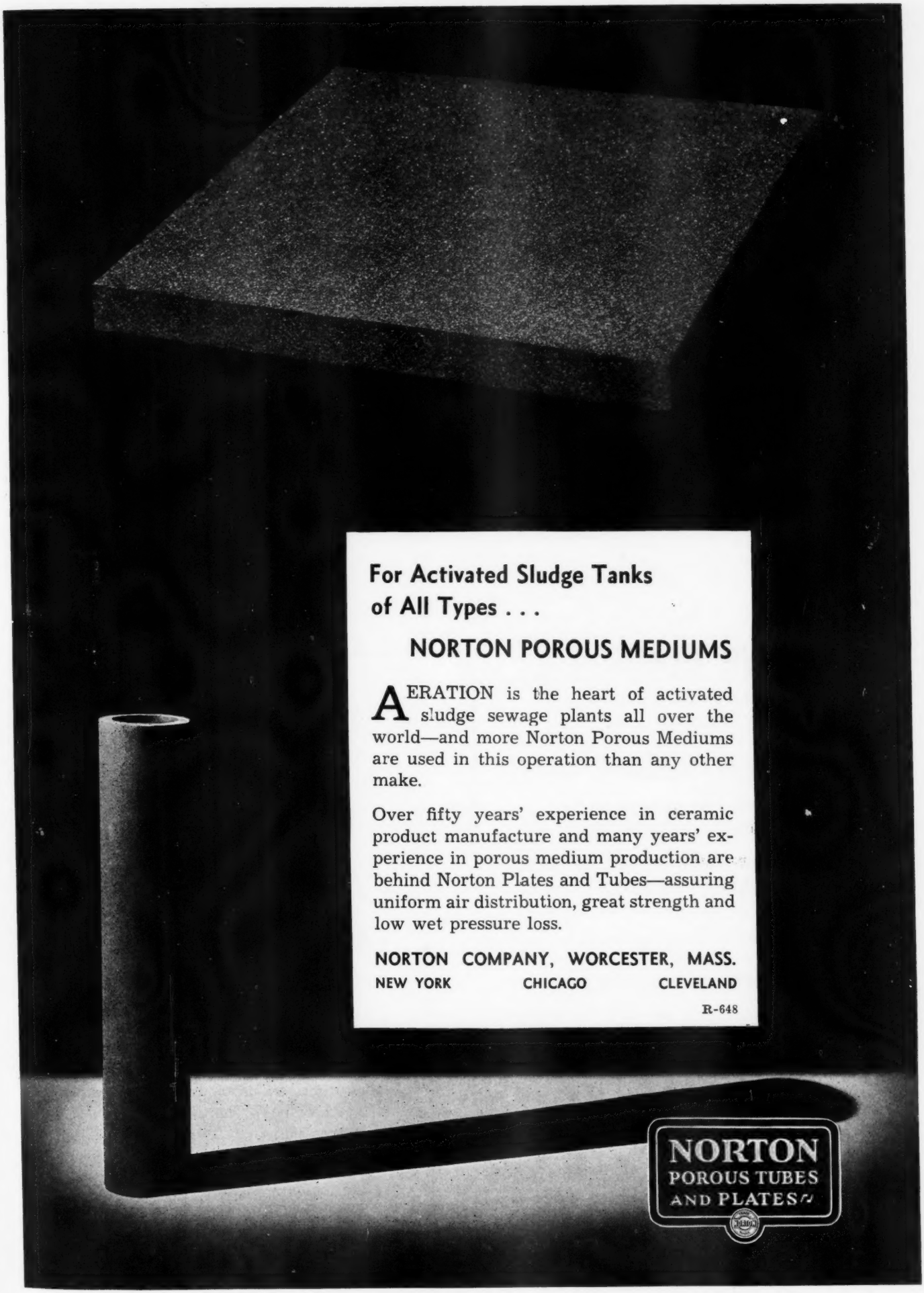
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placed in an aquarium in June and on Oct. 1 were 10% to 15% smaller than those which had remained in the pool.[X19]

Austin's New Refuse Incinerator

Austin, Texas, placed in operation in July, 1939, a new 150-ton incinerator, together with scale house, office, and garage for collection trucks. The plant is 2¼ miles from the center of gravity of haul, located where unburnable rubbish can be dumped for several years. All unpaved streets to be used by collection trucks in reaching the incinerator were paved. There are two 75-ton units, each with storage bin, 3 charging hoppers, one drying hearth and furnace, 3 grates and ash hoppers, and a preheater. The charging hoppers have their tops 3½ ft. above the charging floor to minimize accidents. Ashes are discharged from the grates into ash hoppers, cooled there by water sprays and discharged into trucks in an ash tunnel below. No auxiliary fuel is necessary. Trucks are washed, sterilized and serviced each day. The operating personnel for each shift is a crane operator, an office and scale operator, 2 chargers, 2 clean-up men and an ash man.[J9]

Automatic Control Of Sewage Pumps

At the Manchester Ave. sewage pumping station of Los Angeles, Calif., a maximum pumping rate of 6,000 gpm is provided for against a dynamic head of 67 ft., and a minimum rate of 920 gpm against 28 ft.; with four other rates between these. This is made possible by use of two-speed pumps (2-winding type)—a 6″ running at 695 and 885 rpm and an 8″ running at 715 and 885 rpm; and a single-speed 10″ at 885 rpm. These pumps are controlled by a G.E. automatic multiple-point float switch with 6 points, starting either pump at high or low speed, or combined operation of the 10″ and 8″ high-speed. Also the 10″ is connected to a set of electrodes which start it should the multi-point float switch fail to work. Various colored jewel lamps on the board indicate which pump is running. The pumping rates thus made possible are 920, 1700, 2640, 3800, 5050, and over 6000 gpm.[H19]

Regulated Sandfill Recommended by Experts

A board consisting of four physisians and R. E. Tarbett, senior sanitary engineer of the U. S. P. H. Service, has endorsed the landfill method of disposing of refuse, if conducted strictly under adequate regulations. These include keeping the face of the working fill as narrow as possible; covering exposed surfaces with earth as promptly as possible, leaving all completely covered each night; bulky material that might furnish rat harborage should be at once incorporated with the fill; the final cover should be at least 2 ft. deep; flying dust should be prevented by spraying and flying papers by snow fence; the fill, after compacting, should not exceed 8 ft. depth; water under pressure should be provided for extinguishing possible fires; mosquito-producing pools should be drained; during final compaction, cracks or depressions should be repaired.[E15]

Treating Strawboard Waste

Circleville, O., treats its sewage and trade wastes in two separate plants in the same building. Of the latter, the strawboard waste gives the most trouble. The wastes are dosed with coagulant, mixed and flocculated, and settled in mechanically cleaned tanks. The sludge is pumped directly to a lagoon.

(Continued on page 50)

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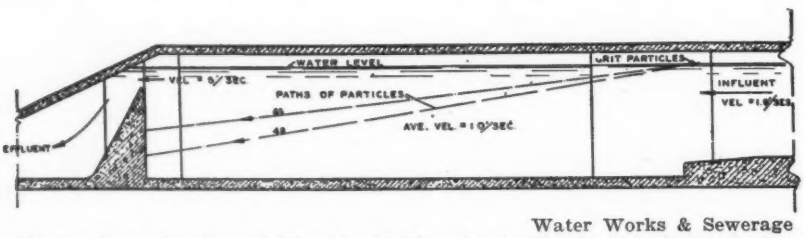
The use of coagulants does not aid greatly in reduction of suspended solids; plain sedimentation gives 43 to 50% suspended solids reduction and 13 to 20% B.O.D. reduction. The yellow color of straw board waste is not reduced by sedimentation, even with the coagulants used. A better method of treating strawboard waste is still being searched for.[J10]

Designing Grit Chambers

Based on experience and studies, the author believes that the capacity of a grit chamber is in direct proportion to its area; that grit particles settle at the same velocity, relative to the moving stream of sewage, as in a quiescent pool; that the chamber should be designed in accordance with the specific characteristics of the grit to be removed, to remove all particles coarser than 65 mesh or, in some cases, all non-organic particles coarser than 100 mesh; the final washed grit should never contain more than 3% by weight of putrescible matter, and should be drained completely of visible free water; the chamber should be so designed hydraulically as to operate readily over the full range between maximum and minimum flows without appreciable loss of head.[G16]



Water Works & Sewerage

Showing lines of settling of 65-mesh and 48-mesh grit. Chamber deficient in setling area for both, as lines do not reach the bottom.

Bibliography of Sewerage Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

D *The Surveyor*
March 22
18. Bradford Sewage Works Products: Grease Recovery. Pp. 271-272.

E *Engineering News-Record*
March 28
14. c. Setting Manholes by Caisson Method. P. 49.
15. Health Experts Endorse Landfills. Pp. 54-55.

G *Water Works & Sewerage*
April
16. p. Grit Removal from Sewage. By W. A. Kivell and N. B. Lund. Pp. 176-185.
17. p. Grit Chambers: Modern Mechanized Design. By M. B. Tark and J. J. Gilbert. Pp. 186-189.
18. p. Collection and Washing of Grit. By R. D. Nichols. Pp. 190-193.

H *Municipal Sanitation*
April
19. Continuous Pumping in a Remodeled Station. By F. W. Parsons. Pp. 182-184.
20. Sludge Incineration at Columbus, O. Pp. 185-186.
21. Designing Settling Tanks. By R. Eliassen. Pp. 187-188.
22. Three Steps to the Lackawanna, N. Y., Treatment Plant. By N. Miljevic and N. L. Nussbaumer. Pp. 189-192.

J *American City*
April
9. New Refuse Incinerator at Austin, Tex. By G. Morgan. Pp. 60-61.
10. Treating Sewage and Trade Wastes Separately at Circleville, O. By E. F. Leist. Pp. 64-66.
11. Close Control Operation of Small Sewage Plant. By E. Malinowski. Pp. 77-79.

P *Public Works*
April
23. n. Cast Iron Liner Plates Protect New Orleans Sewer. P. 42.
24. Getting Results From an Overcrowded Sewage Plant. Pp. 58-59.
25. Design Notes for Small Sewage Treatment Works. Pp. 60-61.
26. Bio-Filters, Aero-Filters and Other High-Rate Filters. Pp. 62-74.

X *Proceedings, New Jersey Sewage Works Ass'n.*
Year of 1939
2. Precautions to be Taken in Handling Sewage Gas. By J. B. Klumpp. Pp. 2-8.
3. Report of Committee on Gas Hazards at Sewage Treatment Plants. Pp. 9-16.
4. Hazards Produced by Sewage Gas and Their Effect Upon Fire and Explosion Insurance Rates. By R. M. Cadman. Pp. 17-23.
5. New Jersey's Rights in the Interstate Delaware River. By J. H. Allen. Pp. 24-32.
6. Late Developments at the Plainfield Joint Sewage Disposal Works. By J. R. Downes. Pp. 39-43.
7. t. Sludge Digestion and Methane-Producing Bacteria. By H. Heukelekian and B. Heinemann. Pp. 52-57.
8. Removal of Suspended Solids From Sewage Liquors by Filtration. By W. C. Laughlin. Pp. 58-72.
9. Industrial Waste and Municipal Sewage Plants. By R. L. Carr. Pp. 73-79.
10. Advantages of Interstate Action to Abate Pollution. By S. G. Hess. Pp. 80-85.
11. Practical Operation of the Lakeland, N. J., Treatment Plant. By W. Lafferty. Pp. 86-88.
12. Sewer Assessments and Rates. By E. Hyland. Pp. 89-91.

X *Ohio Conference on Sewage Treatment*
Year of 1939
13. Activated Sludge Control. By J. R. Palmer. Pp. 11-25.
14. The Ohio River Pollution Survey. By H. W. Streeter and E. S. Tisdale. Pp. 26-40.
15. Administration of Sewage Works. By F. O. Wallene. Pp. 41-45.
16. Discussion of Civil Service. By G. E. Barnes. Pp. 46-49.
17. A Study of Milk Waste Treatment. By B. F. Hatch and J. H. Bass. Pp. 50-91.
18. Flocculation of Sewage Without the Addition of Chemicals at Massillon, O. By R. F. Snyder. Pp. 92-98.
19. Final Tank Effluent Used to Maintain Fish Life at Lima, O. By C. W. Prentice. Pp. 99-101.
20. Sampling Final Tank Sludge at the Findlay Sewage Treatment Plant. By R. W. Bowman. Pp. 102-103.
21. Safety Features of the Imhoff Tank Reconstruction at Dayton. By W. B. Nagel. Pp. 104-106.

Keeping Up With New Equipment

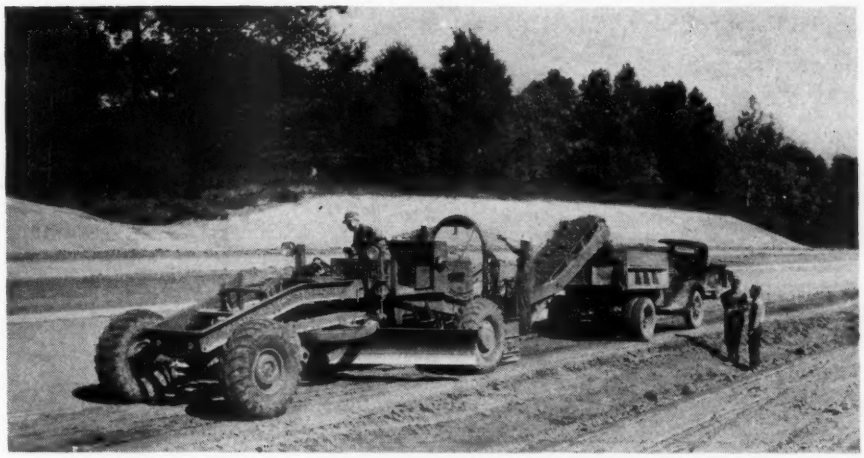
"The Seeing Eye of Excavation"—The Pipe Anticipator

A new automatic signal device, designed to forewarn the excavator operator by an audible signal as his bucket approaches hidden underground service pipes or cables, has been announced by Wallace & Tiernan Products, Inc., Belleville, N. J. who will furnish full information. Known as the WTP automatic pipe anticipator, this new unit is said to pay for itself, on difficult jobs where pipes are many and work is slow, in as little as one or two days.

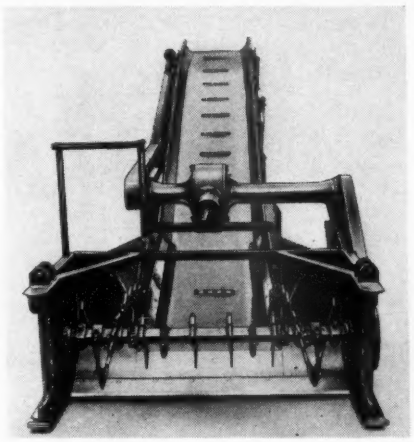
The pipe anticipator is recommended for use in street excavation for installing or repairing pipe or cable lines, for electric power, communication, traffic signal, fire alarm, water, gas or sewer; for subway, highway or street construction; at power plant and industrial yards requiring any kind of excavation; at petroleum and natural gas pipe line systems, for installation near other lines or for finding, uncovering and repairing existing lines; and for dredging where pipes and cables may exist.

The pipe anticipator may be attached to any type of excavating or pushing machine. It produces a continuous sound which the operator hears either through a loud speaker or ear phones. As the bucket of the excavator approaches a pipe or cable obstruction, the sound volume increases. It is said that the operator requires very little experience to dig to within a few inches of hidden pipes or cables with assurance. Thus, the removal of excavated material, otherwise requiring laborious hand tool methods, may be accomplished quickly and efficiently by machine.

The pipe anticipator in use.



The Austin-Western "99" grader and loader; at left, detail of the loader.



Austin-Western "99" Loader Speeds Shoulder Maintenance

A new means for removing surplus material from shoulders has been developed by The Austin-Western Road Machinery Co., Aurora, Illinois. The "99" loader simplifies and speeds up this work, and reduces the cost. It will handle clay, mud, sod, grass, and all the usual material to be removed from ditches or shoulders, leaving the surface smooth and undisturbed, with the correct slope toward the ditch. Cutting down grass shoulders offers no problem. This unit is a belt conveyor loading attachment for the A-W "99" power grader. The collecting bowl at the bottom gathers the dirt as the grader moves forward, and by means of ribbon screws and cutters, feeds the dirt onto the moving belt. Power for the "99" loader is taken from the main engine. The attachment is suitable for any "99" power grader, new or old, and is capable of picking up and loading into trucks as much as 100 yards per hour at a cost of one-third to one-half of the cost of usual methods.

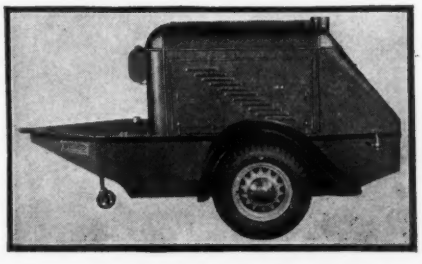
The Cochrane Linameter

The Cochrane Corporation, 17th Street and Allegheny Avenue, announces a new type of meter, the Linameter, which is adapted particularly to the measurement of fluids having characteristics of viscosity, corrosiveness, and solubility such as fuel oil, ammonia, hot tar, etc., which are beyond the scope of the conventional orifice type flow meter.

The meter is made in different combinations of indicating, recording and integrating features to suit particular conditions and may be equipped with pressure and temperature elements to record on the same chart with flow.

The New Littleford Tank Car Heater

This is a flash steam generator, not a boiler. It is light in weight, fully automatic, completely self-contained, and can be used as either a portable or stationary unit. Full pressure is available within 2 minutes; superheat within 5 minutes. Operation cost is very low. Full details and information from Littleford Bros., Cincinnati, Ohio.



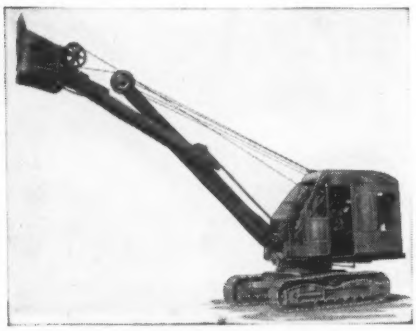
The new Littleford streamlined tank car heater.

Taking the Odor Out of Sewage

Dorex Odor Adsorbers are a new device to soak up odors from sewage and sewage sludge. These are made with coconut carbon and have a long life due to their ability to adsorb large volumes of vapors. They have been used on garbage dumps and in other places, among them being the Ward's Island, N. Y., sewage treatment plant and the Rikers Island garbage dump. Full data from W. B. Connor Engrg. Co., 114 East 32nd St., New York.

Link-Belt Speeder ½-yd. Shovel

A new ½-yd. shovel-dragline-crane, the model LS-60, has been announced by Link-Belt Speeder Corp., Chicago, Ill.



Link-Belt Speeder ½-yd. Shovel.

The manufacturer stresses the strong construction and reserve power of this new shovel, and its quick conversion from one attachment to another without mechanical alteration. Full information on request.

Dorrco V-Type Sludge Pump

This is an entirely new type of diaphragm sludge pump. The length of stroke, and therefore the capacity can be varied at will during operation. At present only the 4-inch duplex is available, but a 6-inch duplex will soon be furnished. The pump is basically of the suction type and will operate against only moderate pressure heads—2 to 3 feet. An excellent bulletin is available. The Dorr Co., 570 Lexington Ave., N. Y.

New Rex Units for Small Sewage Treatment Plants

Recognizing the need of mechanical equipment designed and built particularly for the small sewage plant, the Chain Belt Company, Milwaukee, Wisc., has developed a mechanically cleaned bar screen, grit collecting equipment, and a conveyor sludge collector especially for this service.

The streamlined, mechanically cleaned bar screen is available for new or existing channels with a maximum width of 3 feet and a maximum depth of 5 feet. The screen may be used with or without a triturator.

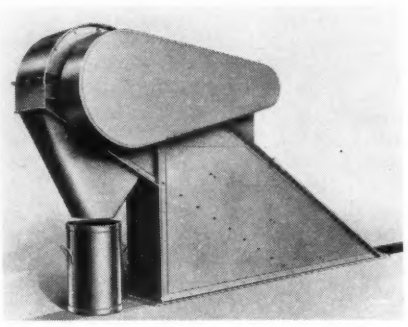
The new grit collector unit is suitable for flows up to about 4 m.g.d. and is installed in a simple concrete channel with all machinery above the channel enclosed in a neat housing. Careful design assures grit of good quality for easy disposal.

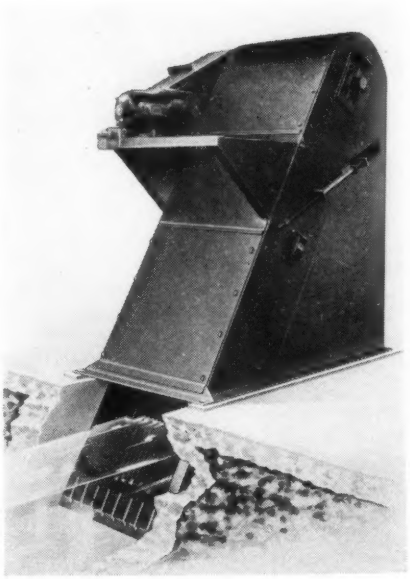
Primary or secondary sludge tank collectors can be furnished for use in tanks up to 10 feet in width by 50 feet in length.

New Fairbanks-Morse Two-Stage Pumps

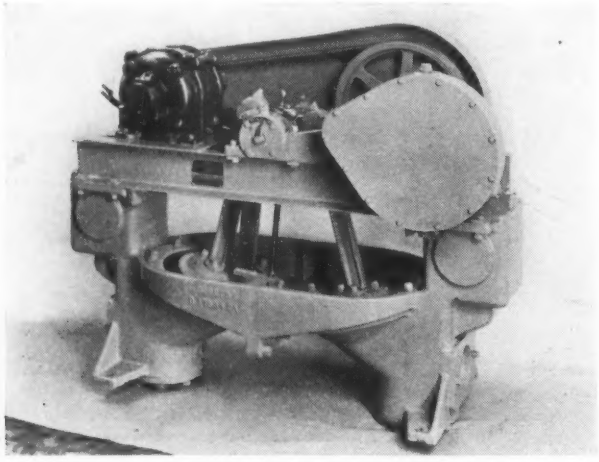
For pumping equipment at head conditions above the range of single stage types, Fairbanks-Morse has developed a line of two-stage, split-case pumps with capacities up to 550 g.p.m. at heads ranging up to 600′ t.d.h. These units are suited to all classes of general pumping service where the liquid is of low viscosity and free from foreign matter; they are used for water supply to high buildings, small municipalities, industrial and process plants, for boiler feed, hydraulic elevators, etc.

One-piece impellers are made of cast iron, hard bronze, or other alloy depending on requirements. They are mounted "back to back" on the shaft to assure proper hydraulic balance. Removable wearing rings with streamlined water guiding surfaces are provided on both casing and impeller. Fuller data on request from Fairbanks-Morse Co., 600 So. Michigan Ave., Chicago, Ill.



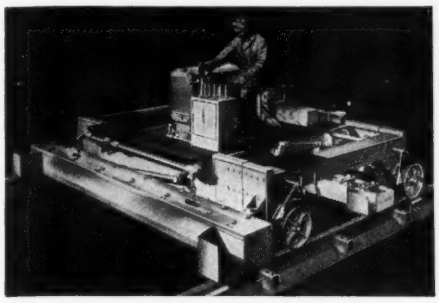


Rex Small sewage treatment units. Top to bottom: Collector, grit collector and bar screen.



The new Dorr V-type sludge pump.

Fairbanks-Morse two-stage pump.



The new Jaeger finisher.

Jaeger Type "H" High Capacity Finisher

A type "H" de luxe finisher, designed to keep pace with 34-E dual drum pavers and Jaeger screw spreaders on any width of slab, has been announced by The Jaeger Machine Company. One heavy duty, automotive type transmission, with working speeds up to 18 f.p.m. and traveling speeds up to 100 f.p.m., performs all transmission functions. Width changes up to 4 ft. are possible merely by extending telescopic trusses and drive shafts and inserting screed sections. For major width changes, up to 32 ft., it is only necessary to insert wider trusses, screeds and drive shafts. Width changes of ¼" to 3" require only shifting washers on the square axles. The improved quick crown change screed, which requires movement of only one lever to change crown over-all, can be furnished.

For vibratory concrete, the finisher can be equipped to operate with either vibratory tubes or vibratory motors mounted direct on the bull-nose front screed to insure deep, internal vibration of the material. Illustrated specifications may be obtained by writing The Jaeger Machine Company, Columbus, Ohio, or nearest distributor.

A New Mobile Water Purification Unit

There has been a good deal of interest in small mobile water purification units. These are needed by the army for field work, by CCC camps, by hotels, resort camps, contractors and many other places. Proportioneers, Providence, R. I., has just announced a unit that seems to be just about right. This consists of an anthrafilt filter, a 40 gpm. pump, chlorination and chemical feed apparatus and an aircooled engine for power. The capacity, when filtering is about 20 gpm.; as a pumping and chlorinating outfit, 40 gpm. The filter is cleaned by backwashing in the usual way. It should prove valuable for field water supply.

Alan Drake Joins Alco

Last month it was announced that Hugh Corrough had been made general manager of Alco Products. C. S. Patton is sales manager. Alan Drake, widely known for his handling of the Buffalo AWWA convention in 1937 and former Director of Water of Buffalo, has also joined the staff.

PERSONAL NEWS

The following new appointments as city managers have been reported:

H. T. Hargrave, Gainesville, Fla.
V. A. Bruno, Pensacola, Fla.
Woodbury Brackett, Houlton, Me.
H. H. Kramer, Milton, Ore.

The following new appointments as city engineers have been reported:

G. E. Garanflo, Little Rock, Ark.
Adolf H. Koebig, Jr., for Monterey Park, Los Angeles, Calif.
Eugene R. East, Trinidad, Colo.
U. F. Turpin, Niles Center, Ill.
Lewis A. Lush, Springfield, Ill.
Russell C. Williams, Washington, Ind.
Wm. P. Henry, for Bonner Springs, Kansas City, Kan.
Guy L. Thomas, Calais, Me.
O. C. Helseth, Crookston, Minn.
Sam Deneke, Fredericktown, Mo.
R. B. Traner, Atkinson, Nebr.
George R. Smith, Pleasantville, N. Y.
Harry D. Bushey, Barberton, Ohio.
Kenneth M. Shaffer, Galion, Ohio.
John R. C. Loyd, Rocky River, Ohio.
H. E. Chase, Ponca City, Okla.
Howard Harer, for Montgomery, Williamsport, Pa.
B. M. Thomson, Charleston, S. C.
E. M. Card, McAllen, Tex.
Thos. H. Coghill, San Antonio, Tex.
Carl Ostlund, Puyallup, Wash.

The following new appointments for water works superintendents have been reported:

Harry Ellis, Acting, Mobile, Ala.
J. N. Caretto, Bisbee, Ariz.
H. Scott Smith, Waterbury, Conn.
W. B. Gibson, Fort Myers, Fla.
H. S. Twisdale, Carbondale, Ill.
Fred Biernath, Staunton, Ill.

A single unit that can handle a wide range of your jobs quickly and efficiently is bound to save you money. With its ready convertibility to shovel, dragshovel, crane, clamshell, dragline, and skimmer, the ¾-yard Bucyrus-Erie 20-B is just such a unit. It has the speed and power to handle sizeable digging jobs in a hurry. You'll find it efficient on street and road work, trenching, foundation excavation, stock pile handling. Its ability to finish up one job and move quickly to another will stretch your work dollars in a host of ways. Find out just what this ¾-yard leader can do for you.

Bucyrus·Erie
SOUTH MILWAUKEE, WISCONSIN

Wm. E. Strehle, Gretna, La.
Allen Goguen, Gardner, Mass.
Lester Hull, Gloucester, Mass.
Lester A. Bridges, Newburyport, Mass.
Lee Sansibaugh, Muskegon, Mich.
John McLean, Gloucester City, N. J.
J. E. Wailes, Tucumcari, New Mex.
Charles M. Clark, Chief Engineer, Board of Water Supply, New York, N. Y.
J. F. Wier, Shelby, N. C.
C. R. Harris, Fremont, Ohio.
Billy Williams, Clinton, Okla.
Al Blaylock, Baker, Ore.
J. W. McArthur, Eugene, Ore.
John Carson, Bellwood, Pa.
J. C. Clark, Lubbock, Tex.
D. H. Vaughn, Markel, Tex.
J. W. Eckles, San Antonio, Tex.

The following county engineers have been appointed:

Frank E. Kelly, Humboldt County, Eureka, Calif.
David H. M. Strong, Jefferson County, Arvada, Colo.
M. L. Plunkett, Richmond County, Augusta, Ga.
W. B. Williams, Miller County, Colquitt, Ga.
Floyd G. Rubey, Page County, Clarinda, Ia.
G. G. Burchell, Clay County, Manchester, Ky.
Aubrey Moss, Benzie County, Beulah, Mich.

At a banquet to William J. Orchard celebrating 25 years with Wallace & Tiernan Co.. Mr. Orchard is shown with Mr. Wallace, left, and Mr. Tiernan, right.

Clarence D. Gibson, Carver County, Chaska, Mich.
J. A. Wood, Chouteau County, Fort Benton, Mont.
Floyd Shaw, Guadalupe County, Santa Rosa, New Mex.
Jess Shadow, Franklin County, Winchester, Tenn.
B. D. King, Wharton County, Wharton, Tex.
W. A. Costello, Skagit County, Mount Vernon, Wash.

Colonel W. F. Rockwell, President of the Pittsburgh Equitable Meter Co. and Merco Nordstrom Valve Co., has been elected a Director of the Commercial National Bank and Trust Co. of New York.

The Union Metal Manufacturing Company, Canton, Ohio, annnounces that they have absorbed the Corrugated Steel Sheet Piling Corporation, formerly of Chicago. Alexander Mayer, formerly President of Corrugated, joins the Union Metal organization as Manager of Sheet Piling Sales. The manufacture of corrugated steel sheet piling, both standard and interlock types, in 8, 10 and 12 gauge steel, will be continued. It is used extensively in the construction of sewers, cofferdams, bulkheads. bridges, disposal plants, dams and similar projects.

The Traffic Control Co., 48 Custom House St., Providence, R. I., has been appointed distributor in New England for the Aeroil Burner Co., Inc., manufacturers of reflector buttons, road stripers and asphalt kettles; and for the Giant Mfg. Co., who make floodlights and swimming pool equipment.

Tapax Mfg. Co., Inc., has removed the office and factory to 117 Spencer Place, Mamaroneck, N. Y.

U.S. Patent No. 2,050,050
Can. Patent No. 442,307

End Noisy Manhole Covers with TAPAX

ON THE IMPROVED LITTLE RED REEL

An easy, economical and practical way to cushion and seat loose manhole covers. A one-man job without mess, bother, or delay. Years of satisfaction in every reel. Write for data, prices, names of users near you.

TAPAX MFG. CO., Inc. 201-3 HOYT AVENUE, MAMARONECK, N. Y.

THE HIGHWAY AND STREET MANUAL

Illustrates good practices in construction and maintenance

The Highway and Street Manual describes and illustrates all types of equipment and materials used in road, street and highway construction and maintenance.
Engineers and contractors all over the nation are finding this handy Manual indispensable.
If you don't have a copy, ask how you may obtain one.

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WARCO Heavy Duty MOTOR GRADERS

All modern features—leaning front wheels, full reversing circle, 90° angle bank-sloping blade range, full power control, including power and hand steering. Available with either diesel or gasoline power unit.

W. A. RIDDELL CORPORATION, Bucyrus, Ohio